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AN ANALYSIS OF CALIFORNIA'S ALBACORE FISHERY

By

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ABSTRACT

Historical records of California's sport and commercial albacore fisheries were compiled and analyzed. The results led to hypotheses which offered an explanation for the spectacular failure of the fishery during the 1930's and provided information concerning present-day migration patterns, which has led to predictions.

Albacore movements were markedly affected by sea temperature. The location of some migrations changed by hundreds of miles, depending upon the geographic orientation of optimum temperatures. Each run (as a unit) behaved according to its size or age composition, and fishing success within various ocean temperatures depended upon both the makeup of the migration and its magnitude.

The number of albacore in the seasonal migrations remained fairly consistent during 1950-1961, despite large changes in size composition and an average fishing pressure of over 1,000 vessels.

We can estimate the condition of the albacore resource when equivalent catch data from throughout its geographical range have been assembled and analyzed. This paper is California's contribution to a proposed international exchange.

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FOREWORD

California Department of Fish and Game marine scientists are engaged in extensive, long-term researches into Pacific albacore biology. One significant aspect of these investigations was the discovery that many albacore schools span the ocean each season, migrating through the highly productive grounds off Japan, the Hawaiian Islands, and North America. This indicates that fishermen in the several North Pacific fisheries are harvesting the same population. For the present study, we have assumed these stocks comprise a natural population separate from those in the southern hemisphere.

If this ocean-wide, international resource is to be managed for optimum yield, information concerning the population dynamics is a prime requisite. Such knowledge can be obtained best through mutual planning and exchange of data between the various investigative agencies. The Pacific Marine Fisheries Commission is the coordinating body for albacore research conducted by Pacific Coast states, and our program also is associated informally with that of the U.S. Bureau of Commercial Fisheries. Scientists attending the FAO World Scientific Meeting on the Biology of Tunas and Related Species convened in La Jolla, California during July 1962, formally recognized the need for international cooperation, and Resolution 10 of that meeting recommends action. The resolution has not yet been implemented officially, but it has prompted informal discussions among Japanese and American scientists.

This report updates studies initiated in 1951 (Clemens, 1955). It sets forth results obtained from part of the albacore investigations conducted through 1961, by researchers at the California State Fisheries Laboratory, and complements those of the Oregon Fish Commission (Ayers and Meehan, 1963). We hope it will serve to guide others in reporting albacore catch data.

Our venture encompassed the eastern North Pacific and annually depended upon hundreds of individuals volunteering their unstinting assistance. Ship's logbooks furnished much of the basic information. They were kept routinely by skippers operating California's great sport and commercial albacore fishing fleets, and success would have been impossible without their excellent, all-out cooperation and support; therefore, we dedicate this publication to them.

The Department's state-wide catch records also proved invaluable. These were regularly maintained and processed at Terminal Island headquarters by conscientious, professional personnel. The entire tuna research staff contributed at every opportunity; they sampled fishing boat catches, copied logbooks routinely at major California ports, and planned and carried out extended sea cruises in cooperation with the hardworking crew of our research vessels *N. B. Scofield* and *Alaska*. To these people, we extend our sincere thanks and appreciation for a job well done.

Part of the work upon which this paper is based was supported by the U. S. Bureau of Commercial Fisheries, contract No. 14-17-0001-575; and the 1961 fleet catch data were compiled on the 7090 computer at Western Data Processing Center, University of California Graduate School of Business Administration, Los Angeles. We are grateful for this support.

—*Harold B. Clemens and William L. Craig, August 1964*

INTRODUCTION

The United States ranks with the world's foremost fish-producing nations, and California's tremendous fisheries head the list of states in both production and value. Albacore, *Thunnus alalunga*, are highly desirable to both sport and commercial fishermen, sharing honors with the state's three most important species.

Over the past 20 seasons (1942-1961), the commercial albacore fleet, plying azure waters from central Baja California to British Columbia, has landed 310,000 tons in California (Figure 2). This harvest brought

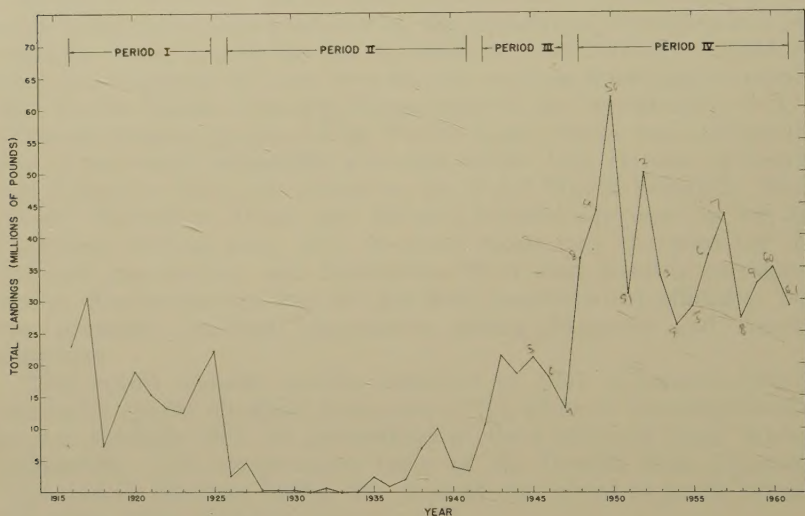


FIGURE 2. Albacore landings in California by commercial fishermen during calendar years 1916-1961 divided into 4 periods by magnitude. Appendix A details origin and amount of imports.

an estimated \$115 million to the fishermen, excluding its large additional value to those engaged in processing and distribution. Records for the 15-year, post-war period (1947-1961) show the southern California partyboat industry, which operates primarily between northern Baja California and Point Conception, California, has taken multitudes of recreation-seeking men, women, and children sportfishing for albacore (Figure 3). These enthusiasts boated more than 900 thousand "longfins" weighing nearly 7 thousand tons, which would have been worth over \$2 million at prevailing commercial prices (Figure 4). In addition, anglers aboard private yachts and their bag of these highly prized tunas increased significantly, though we obtained no detailed records concerning such catches (Figure 5).

The wealth created by our fishery is shared by those associated directly with various albacore commercial and sportfishing industries, and by all of the state's residents through indirect monetary benefits. No one has been able to place a dollar sign on a person's well-being, so it is impossible to use that yardstick for measuring the windfall of



FIGURE 3. Partyboat angling for albacore. Photograph courtesy of Pierpoint Landing.

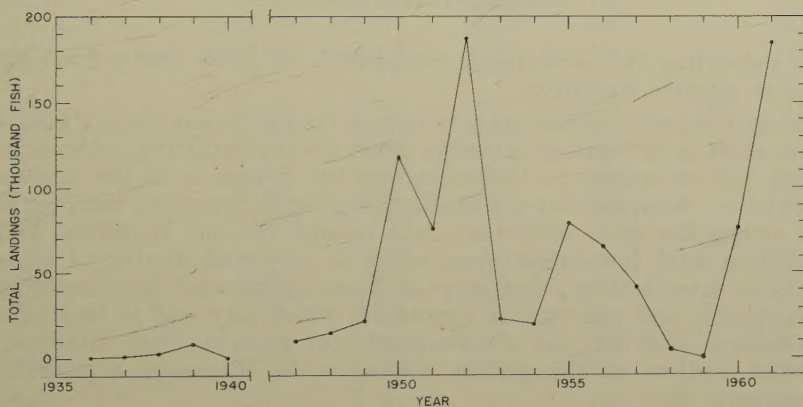


FIGURE 4. Number of albacore caught by California partyboat anglers, 1936 through 1961, excluding World War II years.

healthful recreation gained by our citizens through sportfishing—we believe, however, it is priceless. Albacore are a renewable natural resource which, if used intelligently, can yield wealth and recreation year after year. Large annual catch fluctuations, however, characterize the fishery and confront commercial fishermen with an uncertain livelihood. This, in turn, affects our domestic economy, for when albacore are harvested in abundance, millions of dollars are injected into California's economic bloodstream; when few are caught, it is deprived.



FIGURE 5. Private albacore fishing vessel. Photograph courtesy of Elmer Hehr, Mission Bay Research Foundation.

Understanding the mechanisms responsible for these fluctuations may lead to greater stability.

A chief objective of marine scientists at the California State Fisheries Laboratory is to focus an intensive effort toward obtaining information which will contribute to understanding the dynamics of the albacore population. Adequate catch statistics covering an extended time period are among the most important data needed for our inquiries. They provide a solid foundation upon which to plan and implement sound scientific investigation; they serve as basic background information to help develop and test various hypotheses which may lead to improving the fishery; and they are a prerequisite for studying such vitally important matters as changes in fishing locale, intensity, availability, abundance, etc.

This paper is concerned with results from these basic lines of inquiry, and we have included numerous charts revealing the most productive sport and commercial fishing areas each month for an extended period. These data are the key with which we can examine the oceanic environment and unlock additional albacore behavioral secrets.

HISTORY OF COMMERCIAL FISHING

Pacific albacore are fast-traveling creatures of the open, wind-driven sea. These cosmopolitan speedsters regularly traverse the North Pacific while swimming more than 500 miles per month. Most avoid the cold, green water associated with islands and continental land masses, pre-

ferring the deep blue seas of temperate regions where they abound in the upper, mixed layer during their far-ranging, relentless migrations.

Every spring and summer a varying portion of the albacore population, comprising primarily 1- to 4-year-olds, migrates eastward from central North Pacific climes and enters the realm of American fishing fleets. Individuals have been taken off Mexico's mainland at Clarion Island, of the Revillagigedo group, and northward along the coast into the Gulf of Alaska. The most productive fishing grounds, however, are between central Baja California and the Columbia River. During the 20 years 1942-1961, well over 75 percent of more than 800 million pounds harvested in the eastern North Pacific were caught by hook and line and landed in California (Table 1).

TABLE 1

Total Pounds (in thousands) of Albacore Landed in Northeastern Pacific Ports by Commercial Fishermen, 1936-1961 (Obtained from the Various State Agencies and the Canadian Department of Fisheries).

Calendar year	California	Oregon	Washington	British Columbia	Alaska	Total
1936	946	28	---	---	---	974
1937	2,020	1,354	333	---	---	3,707
1938	6,815	8,000	4,132	---	---	18,947
1939	10,000	6,485	2,444	284	---	19,213
1940	3,941	9,286	1,330	4	<1	14,561
1941	3,341	7,545	1,045	76	---	12,007
1942	10,621	10,943	1,976	---	---	23,540
1943	21,385	10,496	5,755	29	---	37,665
1944	18,454	22,492	11,870	464	---	53,280
1945	21,225	12,178	6,030	1,429	---	40,862
1946	18,078	3,951	2,123	432	---	24,584
1947	13,172	9,558	4,243	797	---	27,770
1948	36,456	8,004	4,917	2,175	132	51,684
1949	44,006	6,457	4,434	2,231	---	57,128
1950	61,745	5,386	5,035	2,119	27	74,312
1951	30,915	2,917	625	190	---	34,647
1952	49,804	2,586	177	157	---	52,724
1953	33,836	776	89	11	---	34,712
1954	26,107	469	421	---	---	26,997
1955	29,002	503	233	---	---	29,738
1956	37,055	3,654	630	---	---	41,339
1957	43,525	2,702	433	38	---	46,698
1958	27,188	9,754	1,503	18	---	38,463
1959	32,740	10,582	2,961	164	---	46,447
1960	35,113	4,563	526	468	---	40,670
1961	29,123	3,251	456	10	---	32,840

The Hook and Line Fishery

In 1903, there were no sardines, *Sardinops caeruleus*, in San Pedro Bay to keep A. P. Halfhill's packing plant operating, so he began to experiment with "albacore, halibut and rock cod" (Halfhill, 1951). He discovered that albacore turned white and tasted delicious when steam-cooked. During that year, 700 cases were packed and sold as "tuna"—if they had not been so labeled probably none would have sold, for in those days albacore were considered to be undesirable nuisance fish. Thus, a sardine failure in southern California resulted

in the birth of America's tuna-canning industry—now one of the world's largest. This enterprise grew and prospered over the years, processing an average of 20 million pounds annually prior to 1925 (Halfhill, 1951). Our records are incomplete for the early seasons, but they show that 23 million pounds of albacore were caught in 1916. Increased demand for sea food during World War I gave this fledgling industry added momentum, and several cannerys experimented with bluefin tuna (*Thunnus thynnus*), skipjack (*Katsuwonus pelamis*), and yellowfin tuna (*Thunnus albacares*).

During the summer of 1918, many albacore failed to migrate into the southern California grounds, and the catch dropped from 31 million pounds the year before to only 7 million. As a result, fishermen and cannerys turned to our bluefin tuna resource for help in satiating market requirements. Quantities of bluefin were available locally during each season's warm months, and in 1919, when complete records were first kept, 15 million pounds were landed. This budding fishery ranged only a few miles offshore from Point Conception to near the Mexican border until 1930, when the first bluefin were netted by purse seine off Guadalupe Island, Baja California (Godsil, 1949).

Albacore fishing improved somewhat in 1919, but the combined albacore and bluefin catch was not sufficient to supply the market's rapidly accelerating demands, so fishermen looked toward the tropics and the vast skipjack and yellowfin tuna resources. During the summer months of warm years, these two species ranged northward into southern California waters, where a combined total of 10 million pounds was caught in 1918–1919. Fishing off Baja California began in 1919 for skipjack and 1920 for yellowfin. By 1927, the tropical tuna catch off Baja California had surpassed albacore and bluefin landings during the poor seasons off California. Albacore fishing south of the border started in 1918, but was negligible there until about 1942.

In the early days, commercial fishermen netted sardines and salted them for bait. Next they located albacore schools by trolling one or two artificial lures at the surface behind their vessel. When a fish struck, the boat was stopped and trolling lines secured; salted bait was then scattered upon the sea to attract and hold the albacore within reach, so they could be caught on baited hooks attached to handlines, and gaffed aboard. When the school quit biting, trolling was resumed and the process repeated. During the years 1903–1929, daily landings of 4 to 6 tons per vessel were common, and less than 1 ton each day was considered a poor catch. After being cleaned at sea, individual albacore were hung to drain overnight in the canneries. This slowed processing and, to avoid overcrowding, buyers sometimes had to establish a 1-ton limit on individual landings (Scofield, 1914).

Sailing vessels were used at the outset of our marine fisheries, but gasoline engines began replacing sails as early as 1893—by 1915, most fishing boats were gasoline-powered (Scofield, 1956). In those days, vessels of about 5 tons capacity driven by 15- to 25-horsepower engines made 1-day albacore fishing trips—out in early morning before daylight and back to port the same evening (Scofield, 1914). Each had a crew of two to six men and carried its own net for catching sardines, anchovies, or smelt, for live bait. These were kept in a tank supplied with fresh, circulating sea water located near the vessel's stern.

Many early commercial fishermen were Japanese; they introduced a method of pole-and-line fishing into southern California called "jap pole" fishing (sometimes referred to as jack-pole, striker, squid, or live-bait fishing). With this technique, albacore first were located by trolling, and then live bait was chummed overboard to hold the school nearby. Fish were caught with a stout bamboo pole having a short, strong line attached to a wire leader and a barbless hook, on which an active bait was impaled. When an albacore struck, it was quickly heaved aboard; no time was lost in gaffing, and each excited fish quickly unhooked itself. Feathered artificial lures, called squids or jap heads, often were substituted for live-baited hooks—especially when fish were biting fast.

In 1925, albacore bait boats averaged 45 feet long, although a few considerably larger vessels bait-fished with fair success. Bait boats were mainly converted sardine purse seiners, while the albacore jig-boat or trolling fleet consisted primarily of salmon trollers and a variety of small market boats averaging 30 feet in length. The larger, powerful boats required costly upkeep and considerable manpower, thus a smaller profit was shared per man; also, live bait sometimes was difficult to net. Trolling, by comparison, was feasible in smaller vessels which were less expensive to maintain and operate; baiting was unnecessary, and one to three (usually two) men sufficed. These economic factors caused many captains to abandon live-bait fishing and turn exclusively to trolling.

Southern California's sportsmen were first to troll for albacore; later, commercial fishermen trailed one or two jigs, but only to locate schools for live-bait fishing—a method that dominated the fishery's early years. Trolling increased markedly between 1920 and 1925, gaining added impetus from skippers experienced in trolling for northern salmon. Many of them sailed south during slack salmon seasons to participate in the albacore harvest. By 1926, surface trolling was responsible for half the catch, and in recent years it has accounted for over 75 percent.

Today's albacore trollers have 20- to 30-foot outrigger poles (usually eucalyptus wood) secured port and starboard. Three to four lines are rigged by steel springs to each pole; these and rubber shock-absorbers, attached about midway on the line, absorb the initial shock of a striking fish. Troll lines are graduated in length with the longest outboard, so each can be hauled inward without tangling the others. In practice, the poles are lowered from a vertical stowed-position, enabling each line with its bone or feathered jig to fish near the surface. Vessels troll at 4 to 8 knots (usually 6), and hooked albacore are hauled aboard while underway.

Fishermen are quick to modify methods and gear if they feel an improved catch will result, and many innovations have been tried with varying success. A few bait-boat captains chummed their one or two trolling lines with salted bait to conserve a limited live-bait supply. Some, upon failing to locate good bait-feeding schools, geared for trolling and took a large percentage of their albacore on jigs. Others have remained with "non-biting" schools and tried to catch a few individuals by fishing deep with live-baited handlines. Jig-boat captains often carried salted bait to chum the trolling lines; when a fish struck, they circled about and cast salted or ground fish upon the surface hoping to

"chum-up" an albacore school. At times, fishermen have used lead weights on jig lines to make them fish deeper and for better control in hauling. One or two captains occasionally set gillnets after a days trolling, although these nets have not been successful in the California fishery. In the final analysis, harvesting methods take advantage of the albacore's visual acuity and hunger.

Several skippers may band together to scout a larger area. This enables them to locate productive grounds more rapidly and to help each other in emergencies. Albacore fishermen also utilize radio-telephones to exchange information on fishing conditions and weather from their particular operating area.

Most albacore caught in the eastern North Pacific since 1940 have been small (weighing < 20 pounds); they traveled near the sea surface in loosely-knit schools comprising widely-scattered school groups. Because of this behavior, trolling was the most efficient way to harvest them. Larger albacore occurred both near the surface and at deeper levels in the ocean's mixed layer. These formed more compact schools, and their groups were not as widely scattered geographically as the smaller ones. As a result, live-baiting was the best fishing method, for it may stop an entire school containing many tons of choice albacore and hold it near the boat for fast "jap pole" fishing. When this occurred, profitable quantities could be decked in a few minutes. The number of large-fish schools, however, was comparatively small and good live-bait fishing frequently was short lived.

The most productive bait grounds were between Point Conception, California, and Geronimo Island, Baja California, where a major bait species is the northern anchovy, *Engraulis mordax*. During July and August, peak live-bait fishing months, many albacore fishermen made bait near San Pedro, Newport Beach, San Clemente, San Diego, Ensenada, Punta San Jose, Cape Colnett, San Martin Island, San Quintin Bay, and Geronimo Island. While these were popular areas, operations were by no means limited to them, for fishermen tried to bait as near as possible to good fishing. Bait-boat captains found an improved albacore harvest north of Point Conception in recent years, and as a result, central California coastal areas became increasingly important as baiting grounds—Morro Bay, San Simeon, Monterey Bay, and San Francisco Bay are a few places where good bait has been netted. No special fee was charged for catching anchovies in California waters, but a Mexican permit was required to take live bait off Baja California.

The Purse-Seine Fishery

Purse seining for albacore in the California fishery has been attempted periodically, but until recently it met with little success. Seiners are at peak efficiency when encircling large, compact, and slow-moving fish schools; most albacore schools in our fishery, however, are small, loosely knit, and travel rapidly, hence seining for them has been unpopular.

During the late 1930's and early 1940's, skippers based in the Pacific northwest tried netting albacore off Oregon and Washington. They claimed that albacore schools of comparable size and density were not found in southern waters (*Pacific Fisherman*, 1939). The success of this venture is not clear, but when fish failed to move into the area during

years of cooler seas, it ended. From the close of World War II through 1959, California seiners caught a few albacore incidental to bluefin tuna fishing. During the 9 years 1951-1959, 19 seiners landed some 60 tons of albacore (Shaver, 1962).

Revolutionary developments in tuna purse-seine gear started in 1959 when skippers began to use larger, lightweight nylon nets and to retrieve them rapidly with new power equipment; in addition, many large, speedy, live-bait clippers from the tropical tuna fishery were converted to seiners (McNeely, 1961). In 1960 and 1961, the resulting fleet netted pure albacore schools as well as those containing albacore and bluefin mixed (Figure 6). This increase in albacore seining occurred



FIGURE 6. Purse seiners sometimes catch albacore. Photograph by William R. Strachan.

when numerous sizeable fish (> 20 pounds) remained on the fishing grounds for an extended period; these "live-bait type" schools were relatively easy to encircle. Many small schools containing large fish were scattered over tremendous areas, and the new, power-driven net-puller made it feasible to set a net on them. In 1960, over 100 tons of albacore were caught by California seiners, and in 1961, almost 1,000 tons were netted (Table 2). It is interesting to note that Canadian seiners, in 1960, caught approximately 150 tons of albacore off the Oregon and California coast (Shaver, 1962). These were unloaded in Canada.

TABLE 2

Albacore Catch (in pounds) by California Purse Seiners

Season	No. of boats	July	August	September	October	Month unknown	Total
1960	14	4,269	125,025	6,035	80,404	-----	215,733
1961	66	231,841	1,591,018	76,608	-----	60,598	1,960,065

Future purse-seine catches will fluctuate from season to season, depending upon the number of seiners, albacore behavior, and the quantity of large fish on the grounds.

COMMERCIAL FISHING RÉSUMÉ

Exploratory fishing, tagging operations, and boat-catch analyses by Japanese and American workers indicate that a major portion of the north Pacific albacore population and the principal spawning grounds are located between Japan and the Hawaiian Islands. Each spring and summer, millions of young fish leave these western climes and swim eastward, creating the American fishery (Figure 7). Depending upon



FIGURE 7. Principal albacore fishing grounds in the North Pacific. Data concerning the Japanese fisheries are from Nankai Regional Fisheries Research Laboratory (1959) and Van Campen (1960). Darkened section represents coastal fishing grounds; light shading represents longline fishing grounds.

sea conditions, the main migration enters our fishing grounds on the south and then turns upcoast; in late fall and winter, the school groups depart westward to join those that remained and are harvested by Hawaiian and Japanese fishermen. North Pacific albacore are fished in some part of their ocean-wide range during every month.

To determine the optimum yield from this migrant, transpacific species, requires considerable information about its life history and population dynamics. Scientists from research organizations throughout the North Pacific have been conducting life-history studies somewhat independently, and have made significant contributions toward a general understanding of the resource. Making good estimates of albacore population parameters, however, will require the united efforts of all agencies, because pertinent statistics from each fishery will need to be combined and analyzed. Initial steps to attain this goal have been

taken by American researchers, who have standardized their methods for collecting and reporting annual catch data.

Scientists at the California State Fisheries Laboratory have gathered catch statistics concerning the California albacore fishery for many years. This information came mainly from logbooks kept voluntarily by numerous fishermen, and from sales receipts required by law (pink tickets), which are compiled and processed regularly by our statistical unit (Calif. Dept. Fish and Game, 1952). Pink tickets have supplied us with monthly landings, number of participating vessels, and the general areas where albacore were fished since 1916. These data illustrate the large annual fluctuations in the harvest that occurred historically; for example, catches ranged from 487 pounds in 1933, to 62 million in 1950. Since 1950, pink tickets supplemented by fishermen's logbooks furnished more specific information about the albacore catch. To prepare a résumé interpreting these historical records, to set forth hypotheses accounting for past events, and to improve our ability to predict the future, we had to obtain a great deal of additional information. For example, exploratory fishing and tag-and-recapture studies equipped us with knowledge of transpacific and coastal migrations (Craig and Graham, 1961; Craig and Caneday, 1962; Clemens, 1963); items identified from albacore stomachs gave information about their feeding activities (Clemens and Iselin, 1963); data obtained by studying scales and length-frequency measurements yielded facts about age

TABLE 3
Calculated Lengths and Weights for Albacore Age Groups

Age	Fork length		Increment (cm)	Weight (lbs.)	Increment (lbs.)
	Centimeters	Inches			
I -----	52	20.5		6.4	
II -----	65	25.6	13	12.6	6.2
III -----	76	29.9	11	20.0	7.4
IV -----	85	33.5	9	28.0	8.0
V -----	93	36.6	8	36.6	8.6
VI -----	100	39.4	7	45.5	8.9
VII -----	105	41.3	5	52.7	7.2

(Bell, 1962) and growth rates (Table 3); and various research cruises revealed facets of albacore schooling behavior and ecology. Sea temperatures also were available; these had been recorded daily for many years at Scripps Institution of Oceanography, La Jolla, and are reasonably representative of conditions on the fishing grounds (Radovich, 1961).

We arbitrarily divided the historical record into four periods, depending upon magnitude of the annual landings. Period I began with the fishery's inception in 1903, but records were not complete until 1916 so we discussed it for only the 10 years 1916-1925. Fishing was fair, averaging 17.4 million pounds. Period II encompassed 16 poor-fishing years (1926-1941), averaging 2.4 million pounds. Period III included 6 years (1942-1947) of fair catches, averaging 17.2 million

pounds. Period IV began in 1948 and continued through 1961; the last season for which we have completed figures. During these 14 years, the fleets experienced good fishing, averaging some 37 million pounds annually.

Period I (1916-1925)

About 300 vessels equipped for 1-day trips participated in the fishery each season during the 10 years of Period I, and although live-bait boats ruled the fleet, trolling gradually increased until jig boats predominated in 1924. Almost all fishing was off southern California with only small, sporadic catches made from northern Baja California waters (Figure 8). Skippers had known since 1912, however, that

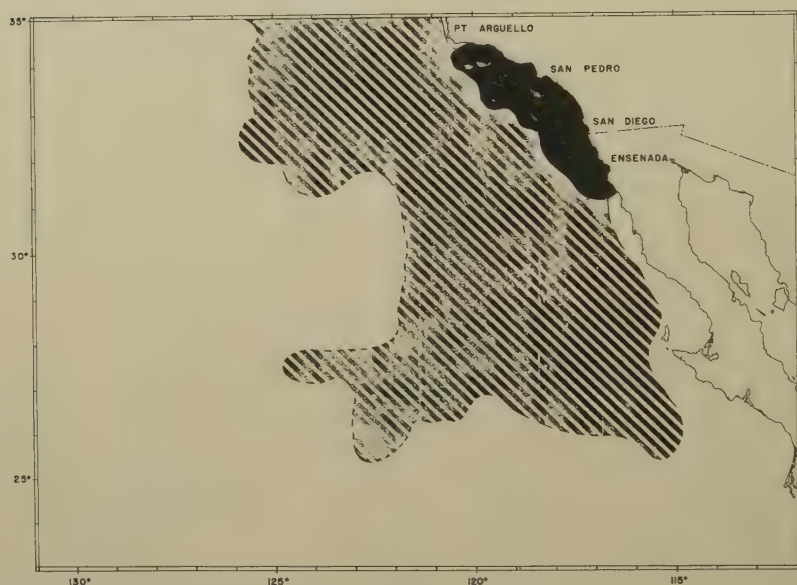


FIGURE 8. Southern fishing grounds of the California albacore fleets. The darkened section shows the Channel Islands area where most commercial fishing took place in early years; today it marks the major sportfishing grounds.

albacore could be taken as far south as Cape San Lucas, Baja California, and northward to more than 250 miles above San Francisco.

San Diego and Terminal Island were major landing ports, and the thriving commercial fishery was supported solely by albacore traveling near our Channel Islands. Sea conditions varied significantly during this period and the catch fluctuated widely; for example, it went from a 31-million-pound high in 1917 to a low of 7 million pounds 1 year later. We offer the influence of sea temperatures on the migration location, changes in number of albacore comprising each size group or year-class, number of year-classes, and capability of the fleet as the best explanations for such variation.

In 1917, sea-surface temperatures were cooler than the long-term mean (Figure 9), and many albacore schools migrated from their winter grounds into Baja California waters to the south before swinging northward along the coast and through the Channel Islands fishing

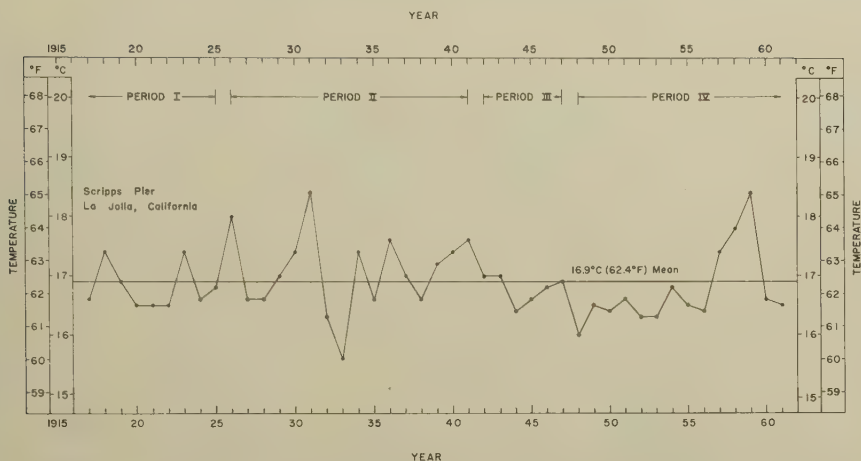


FIGURE 9. Annual average of monthly sea-surface temperatures collected at Scripps Pier, La Jolla, California. Appendix B.

grounds. Albacore heavier than 20 pounds (76 cm) dominated the fishery (Figure 10a; Table 3), and the catch peaked at 30.6 million pounds—a pretty fair harvest even by today's standards.

In 1918, sea temperatures were warmer than average, and although albacore schools again migrated into Baja California waters, the temperature increase was sufficient to make them travel far from shore on their northward trek, beyond reach of the 1-day fishermen. Albacore also were smaller than those of the previous season, averaging about 20 pounds (Figure 10b), and the catch dropped to 7.3 million pounds.

From 1919 through 1922, the sea generally was cooler, and albacore continued to enter waters off Baja California first; conditions were favorable close to shore, however, and they migrated northward within range of the fleet. Both 13- and 20-pounders (Table 3) were plentiful and 6-pound fish made a good showing (Figures 10c, d, and 11a, b). The average catch was 17.1 million pounds, and fishing was most productive in 1920 and 1921.

In 1923, total landings dipped to 12.5 million pounds (lowest since 1918), with 20-pound fish the most numerous (Figure 11c). Sea temperatures warmed and, as in 1918, many albacore schools once again entered Baja California grounds and then traveled upcoast well off-shore.

During 1924 and 1925, the sea cooled and the albacore school groups, comprised mainly of 20-pounders (Figures 11d and 12a), ran well within range of most vessels—landings amounted to 18 and 22 million pounds, respectively.

Period I was especially noteworthy because the fishing grounds were limited in size, fish weighing 20 pounds or better were dominant, and because it included two unusually warm years during which the albacore ran upcoast a considerable distance from shore, causing the catch to decline.

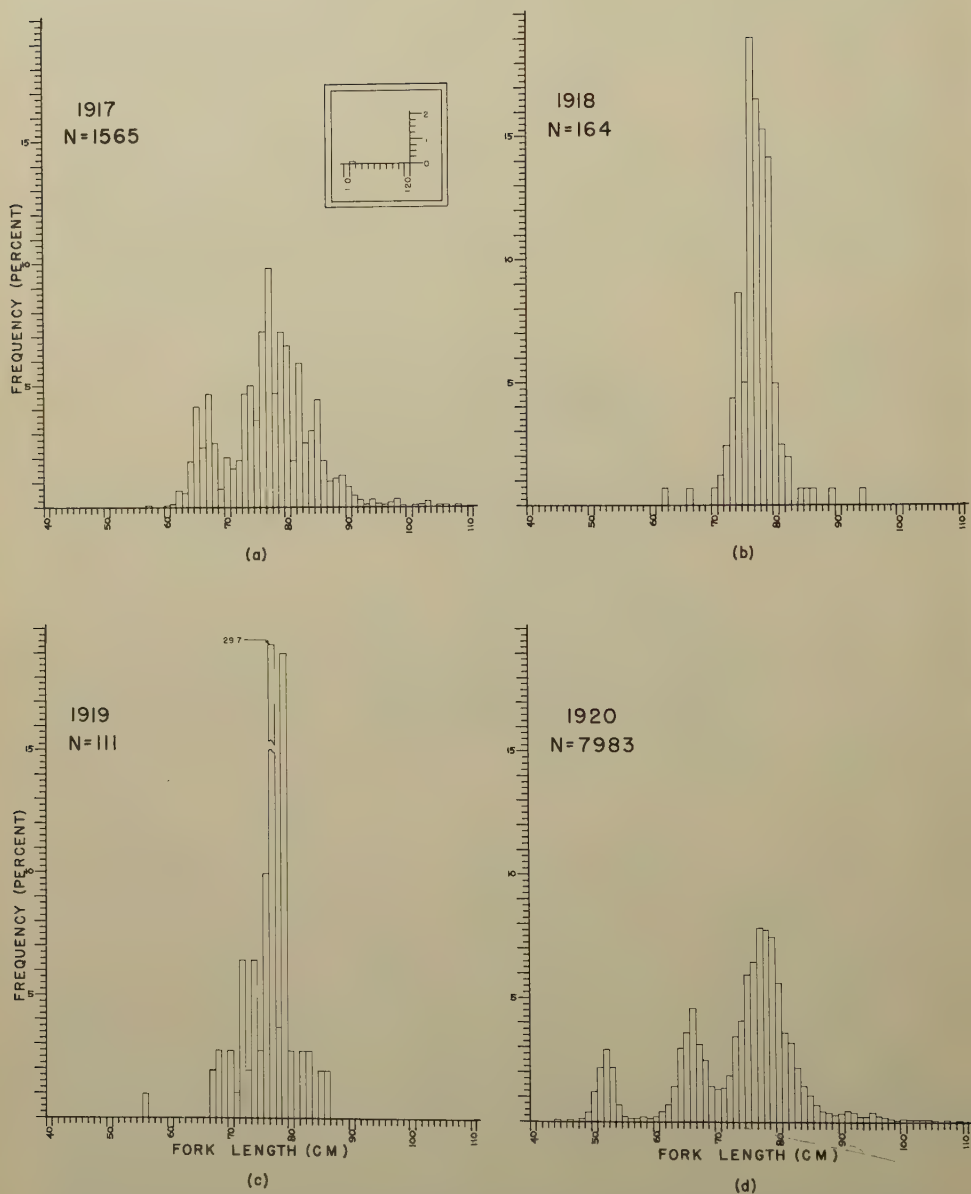


FIGURE 10. Albacore length frequencies (fork length) from the California commercial catch (1917-1920). Appendix C and D.

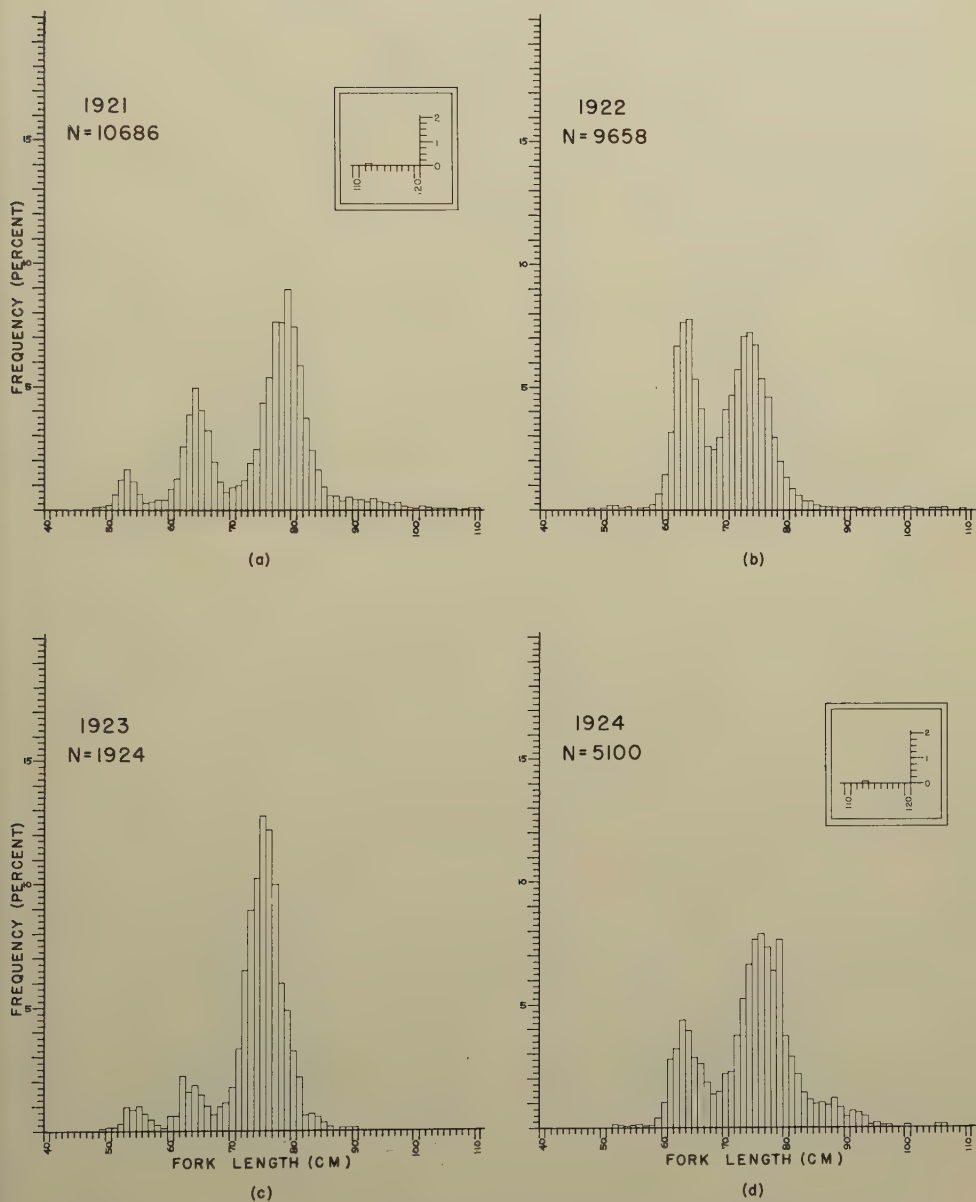


FIGURE 11. Albacore length frequencies from the California commercial catch (1921-1924).

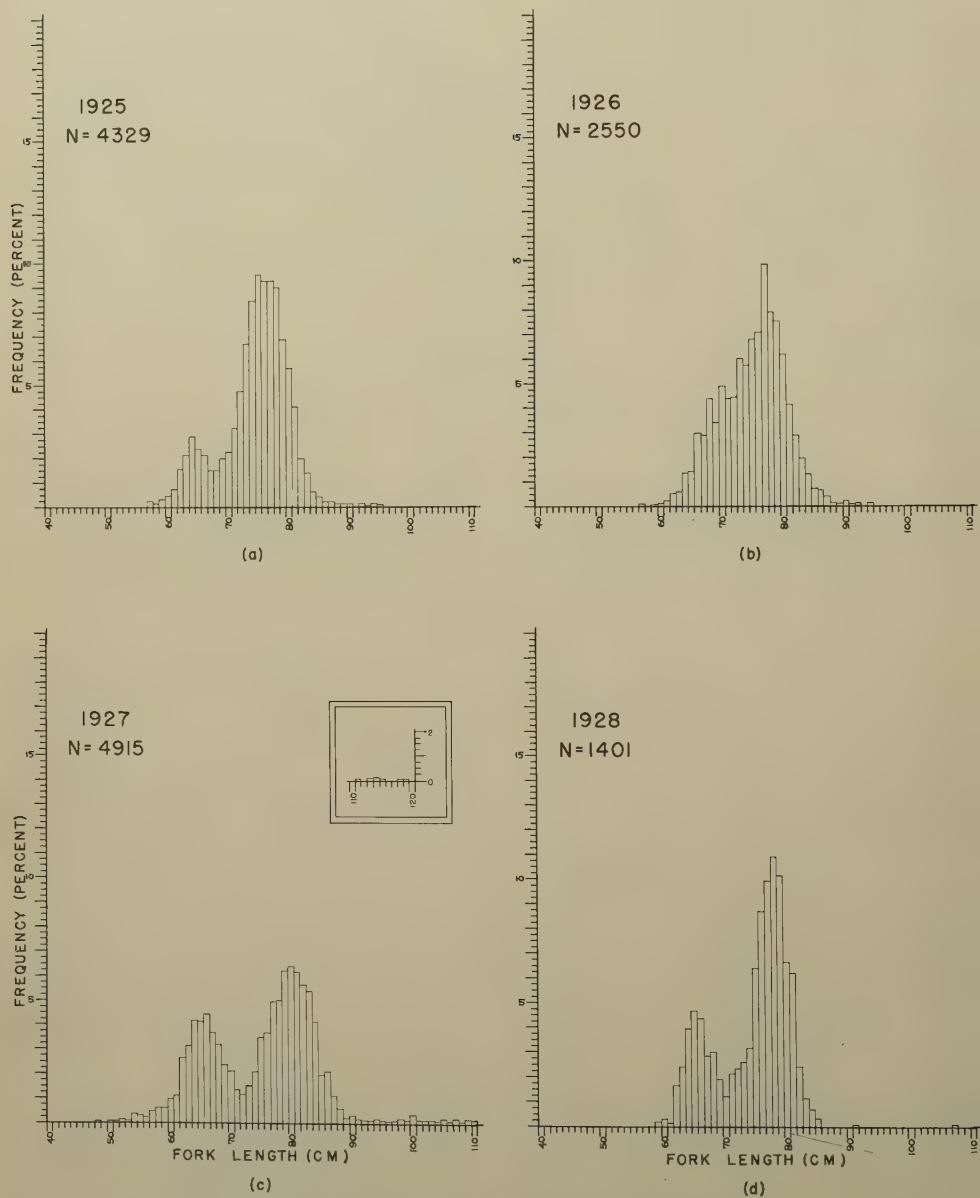


FIGURE 12. Albacore length frequencies from the California commercial catch (1925-1928).

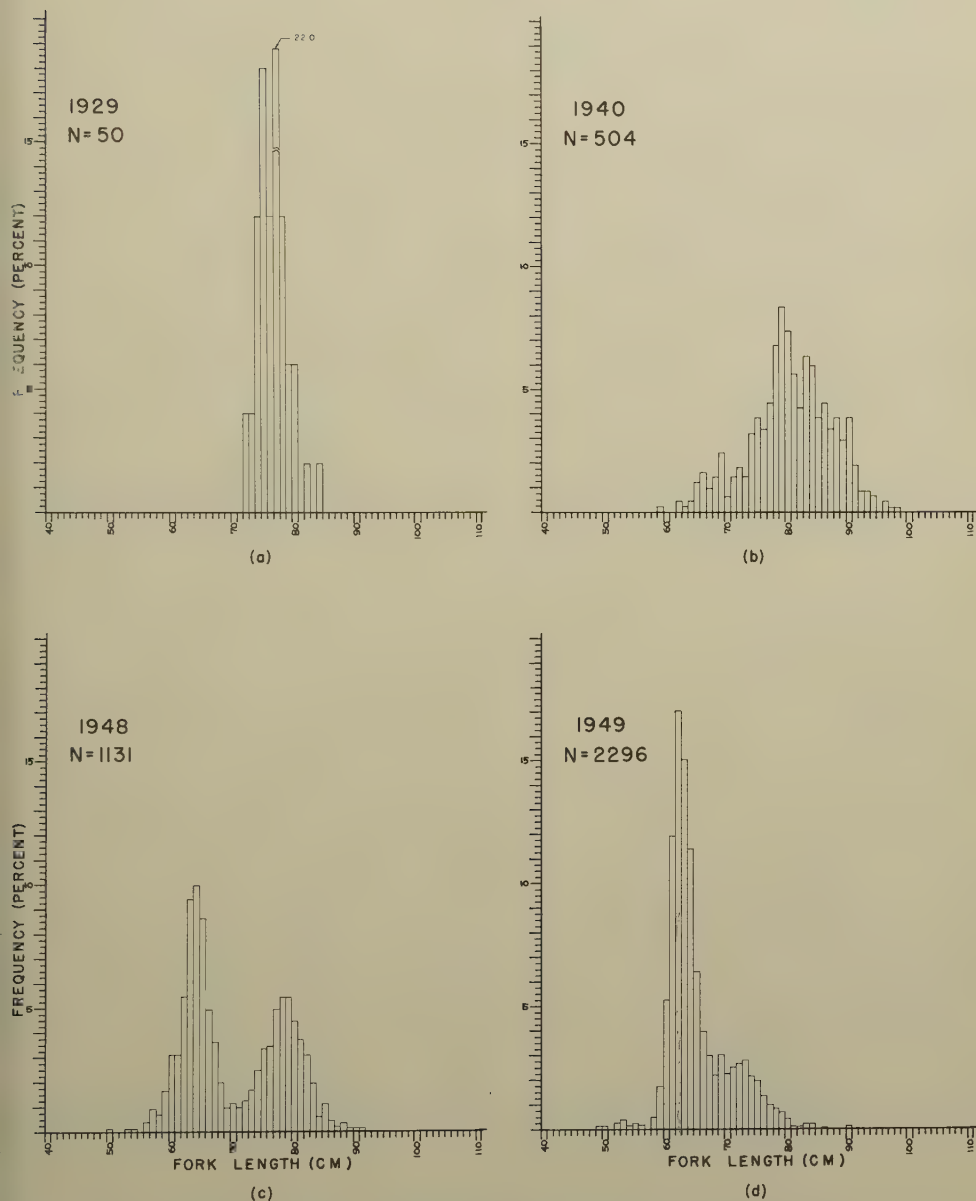


FIGURE 13. Albacore length frequencies from the California commercial catch (1929, 1940, 1948, and 1949).

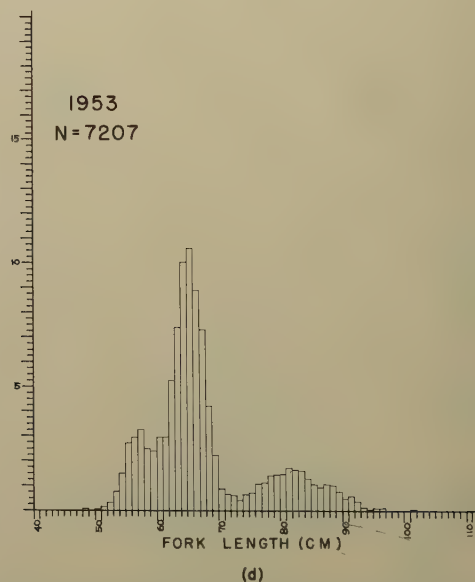
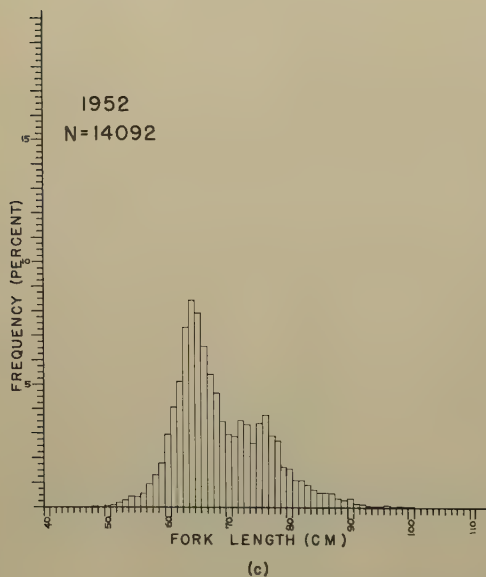
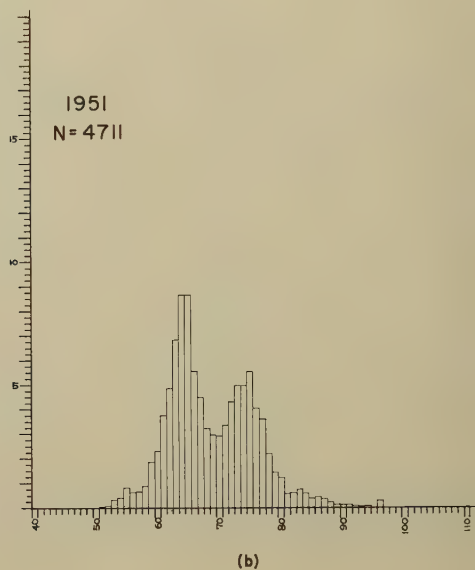
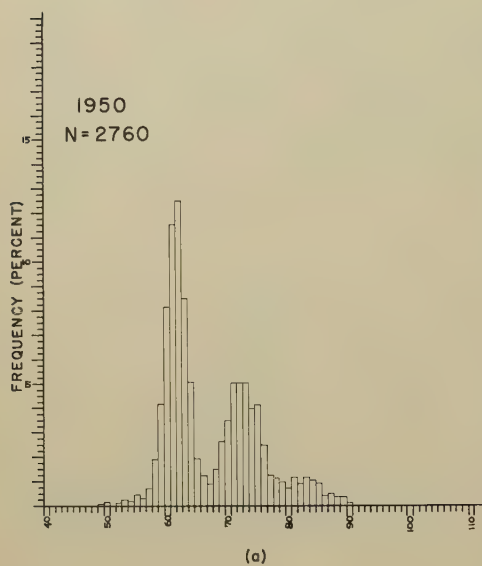


FIGURE 14. Albacore length frequencies from the California commercial catch (1950-1953)

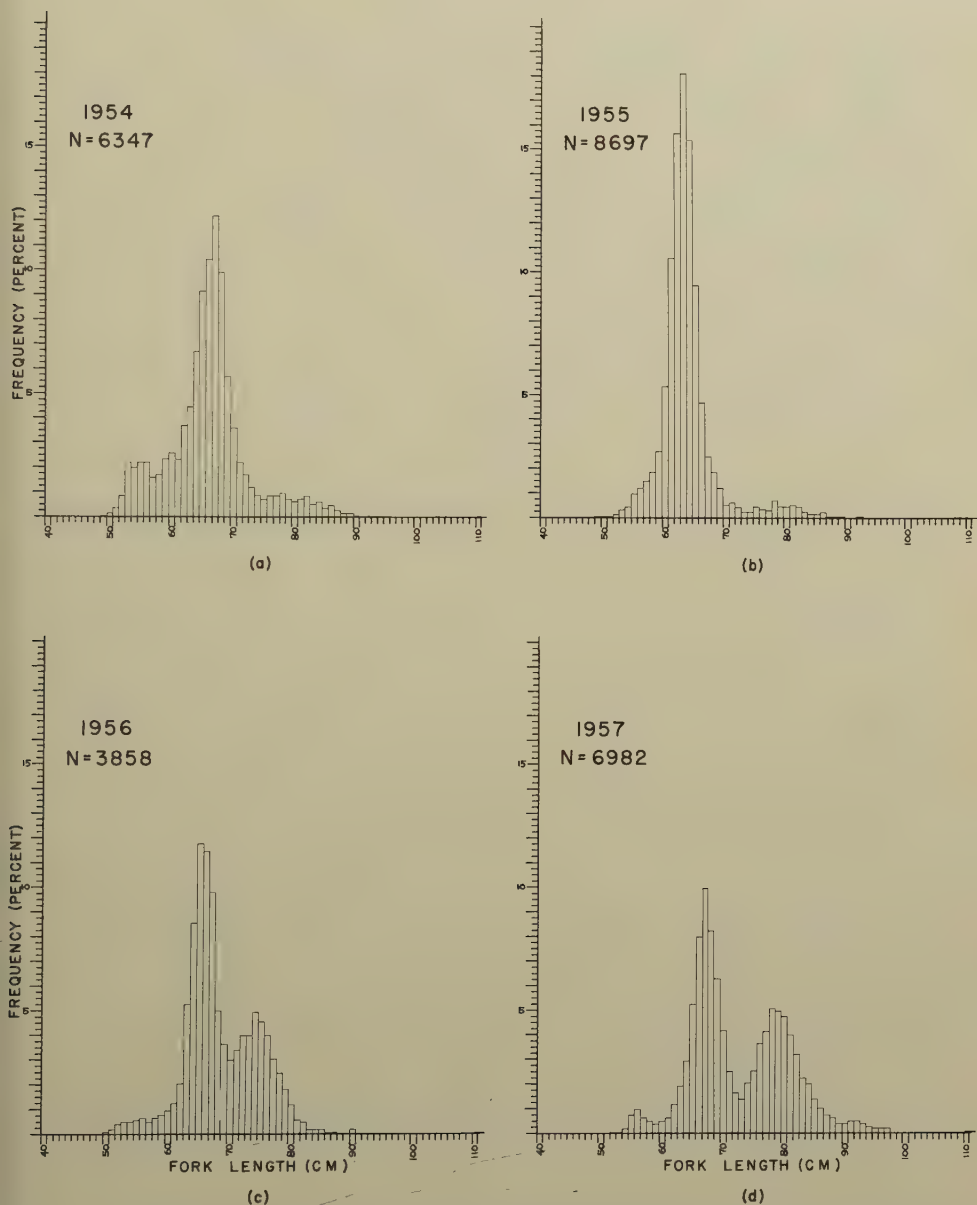


FIGURE 15. Albacore length frequencies from the California commercial catch (1954-1957).

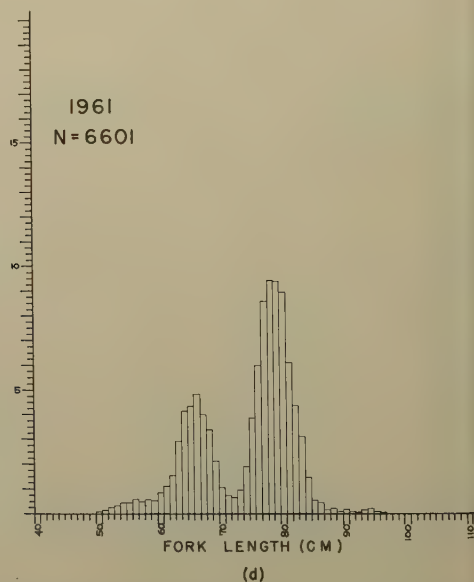
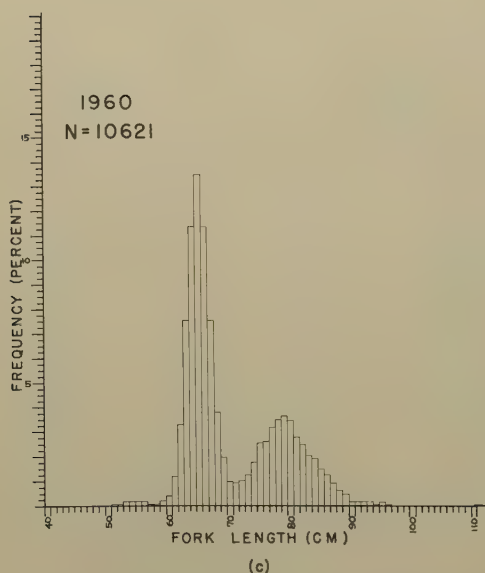
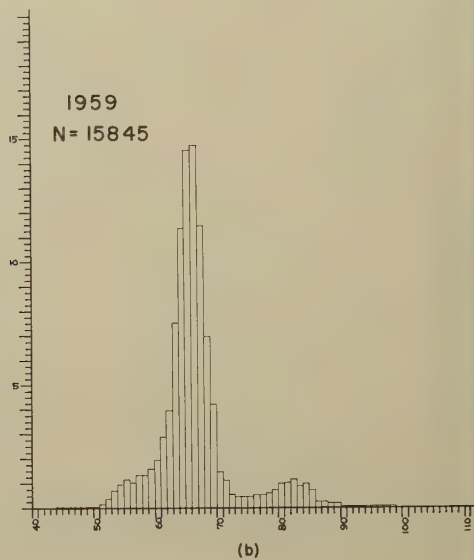
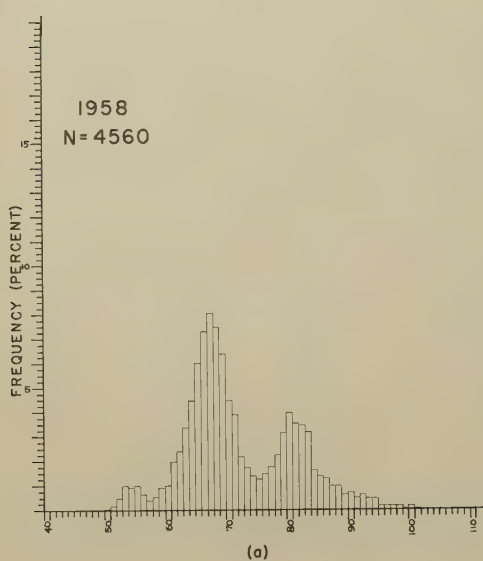


FIGURE 16. Albacore length frequencies from the California commercial catch (1958-1961).

Period II (1926-1941)

The lead-off year was quite different from those in the preceding period. Sea-surface temperatures on the grounds were abnormally high, and ocean heating appeared to be more widespread. Albacore reacted to the warm temperatures during their incoming migration, by traveling into cooler waters north of southern California and then proceeding upcoast. As a result, a major part of the migration bypassed our limited fishing grounds and the catch, which consisted primarily of 20-pound fish, dropped to only 2.5 million pounds. Although 6 colder-than-average seasons (1927, 1928, 1932, 1933, 1935 and 1938) occurred intermittently during this period's 16 years (Figure 9), ocean cooling apparently was neither sufficiently prolonged nor widespread to bring the albacore south again immediately, and total landings were at a record low; the fishery was nearly a complete failure for 7 seasons (1928-1934).

The number of albacore vessels increased irregularly to a peak of over 1,000 before declining, and trolling became the most important fishing method. During the part of this period for which data were available, the trend in landings was associated closely with that for total vessels participating in the fishery (*see* Figure 17). By 1937, most fishermen were using ice to preserve their catch, thus making longer trips possible and enabling them to extend operations into central and northern California. These new grounds provided about one-third of the total catch for this period; landings at Monterey passed the 0.5 million mark for the first time, and a few thousand pounds were landed as far north as Eureka. The albacore grounds were first extended north of California in 1936, when sardine fishermen took several tons off the Oregon coast (Brock, 1943). Landings were reported from Washington in 1937, Canada in 1939, and Alaska in 1940. While this northern fishery was increasing, catches south of California continued small and sporadic. Albacore in the California catch were measured during 5 years (1926-1929 and 1940), and the 20-pounders predominated (Figures 12b, c, d and 13a, b).

Period II was notable because ocean warming pushed the albacore run north of Point Conception in 1926, where it continued to take place each following year until the end of the period; albacore reacted quickly to ocean heating but not to intermittent cooling. During the last 5 seasons, they were caught in abundance far to the north, but poor fishing was the rule on once-productive southern California grounds. Also, vessel captains gradually increased the length of their trips, and albacore fishing spread into central and northern California about a decade after the migration had shifted there.

Period III (1942-1947)

This is the shortest of our four arbitrary periods, with a production average (17.2 million pounds) comparing favorably with that of Period I. It saw substantial improvement in the fishermen's ability to locate and harvest albacore schools, regardless of where the run first penetrated the grounds or whether its northward trek occurred inshore or off. This was accomplished by increased communication between skippers, improved vessel refrigeration systems, larger fuel capacity permitting trips of 10 to 14 days or more, and an ever-increasing fleet that nearly doubled in number during the World War II years.

Albacore landings during this period reached record proportions north of the state where combined fisheries of Oregon, Washington, and Canada accounted for 50 percent of the total eastern Pacific harvest (Table 1). However, after attaining peak production in 1944 they began to decline. Catches in northern and central California areas increased markedly and, at the same time, fishing off southern California and northern Baja California improved somewhat, averaging over 8 million pounds per year. This gradual transition of the albacore run back to more southern fishing grounds took place during a prolonged interval of relatively cool ocean temperatures (Figure 9). By 1947, several mild or cool years in succession had passed, and the incoming albacore schools began to penetrate the southern grounds in full force once again.

We call Period III the "transition period" because it included a steady improvement in fishermen's capabilities to increase the harvest, a persistent cooling in the ocean environment, a gradual change in location of the annual albacore migration, and an end to the dominance of large fish (> 20 pounds) in the catch.

Period IV (1948–1961)

This period is still in progress, though analysis is complete only through 1961. These 14 years began with the second coldest season on record, surpassed only in 1933, and then stayed cooler than the long-term mean for 8 more years before warming (Figure 9). California's fishery matured during this time; the catch was never again seriously affected by the location of the run; 13-pounders were prominent, and landings averaged nearly 37 million pounds annually—more than double the average for any previous period.

Landings north of the state, by other fishermen, were exceptionally low for 7 years (1951–1957) averaging only 2.4 million pounds, and much of this was caught off California; by comparison, fishing thrived to the southward on Baja California grounds (Tables 1 and 4). This period also is typified by tremendous catch fluctuations—not unexpected in a fishery which traditionally has depended upon only two size groups or year-classes (Figures 13c, d; 14a, b, c, d; 15a, b, c, d; 16a, b, c, d).

Many skippers entered the albacore fishery and later abandoned it; thus the number of vessels reached a peak of more than 3,000, declined gradually, and then leveled off (Figure 17). In addition, the catch-trend was associated closely with total number of boats in the fishery until 1955. Most fishermen were well-equipped, capable and experienced in locating widespread albacore schools and concentrating their efforts upon them. Some preferred to remain near home port and await the schools; others started their trips off Baja California and followed the fish northward while ranging hundreds of miles offshore. As a result, harvesting by California fishermen took place from Baja California to Canada.

Many additional data were obtained from fishermen's logs for the 11 seasons 1951–1961. This interval included 6 consecutive cold-water years, 3 of warm water, and 2 that had cooled. Our logbook information lends itself to a more detailed evaluation, so we subdivided the Period IV presentation into smaller intervals.

TABLE 4

General Origin and Pounds of Albacore Landed in the State by California Commercial Fishermen, 1916-1961, Reported by Sales Receipts.
Total Imports also Are Included

Calendar year	California	South of State	North of State	Total	Imports	Grand total
1916	22,899,309	---	---	22,899,309	---	22,899,309
1917	30,556,242	---	---	30,556,242	---	30,556,242
1918	7,263,895	1,527	---	7,265,422	---	7,265,422
1919	13,553,025	77,874	---	13,630,899	---	13,630,899
1920	18,876,647	---	---	18,876,647	---	18,876,647
1921	15,274,528	2,199	---	15,276,727	---	15,276,727
1922	13,231,823	---	---	13,231,823	---	13,231,823
1923	12,488,199	26,634	---	12,514,833	---	12,514,833
1924	17,280,346	415,016	---	17,695,362	---	17,695,362
1925	21,684,942	521,981	---	22,206,923	---	22,206,923
1926	2,469,861	60	---	2,469,921	---	2,469,921
1927	4,455,372	123,995	---	4,579,367	77,592	4,656,959
1928	283,321	---	---	283,321	3,782,408	4,065,729
1929	269,056	45	---	269,101	5,841,229	6,110,330
1930	283,117	---	---	283,117	7,005,568	7,288,685
1931	37,322	---	---	37,322	6,939,079	6,976,401
1932	619,694	---	---	619,694	2,467,521	3,087,215
1933	487	---	---	487	2,793,965	2,794,452
1934	119,829	---	---	119,829	4,167,467	4,287,296
1935	2,386,249	61,279	---	2,447,528	3,231,265	5,678,793
1936	945,595	---	---	945,595	1,510,409	2,456,004
1937	2,020,016	---	---	2,020,016	2,723,693	4,743,709
1938	4,789,880	29,919	1,995,101	6,814,900	6,759,735	13,574,635
1939	8,264,109	4,187	1,732,066	10,000,362	6,422,872	16,423,234
1940	2,387,254	880	1,552,504	3,940,638	3,137,696	7,078,334
1941	3,016,065	---	325,144	3,341,209	973,299	4,314,508

TABLE 4—Continued
**General Origin and Pounds of Albacore Landed in the State by California Commercial Fishermen, 1916–1961,
 Total Imports also Are Included**

<i>Calendar year</i>	<i>California</i>	<i>South of State</i>	<i>North of State</i>	<i>Total</i>	<i>Imports</i>	<i>Grand total</i>
1942	7,998,144	2,623,216	-----	10,621,360	470,506	11,091,866
1943	11,886,148	9,498,716	-----	21,384,864	-----	21,384,864
1944	8,679,273	9,774,659	-----	18,453,932	2,535,547	20,989,479
1945	8,777,991	12,214,180	232,850	21,225,021	108,758	21,333,779
1946	9,116,647	8,958,818	2,434	18,077,899	-----	18,077,899
1947	7,395,765	5,762,119	13,867	13,171,751	255,530	13,427,281
1948	10,499,390	25,901,589	55,167	36,456,146	1,153,643	37,609,789
1949	20,417,078	23,541,172	48,030	44,006,280	284,040	44,290,320
1950	38,139,296	23,575,512	30,396	61,745,204	4,378,420	66,123,624
1951	13,284,606	17,621,586	9,150	30,915,342	17,520,891	48,436,233
1952	23,103,074	26,697,061	3,389	49,803,524	22,525,248	72,328,772
1953	13,297,627	20,490,810	47,468	33,835,905	46,186,816	80,022,721
1954	14,289,095	11,818,195	-----	26,107,290	38,466,383	64,573,673
1955	9,312,029	19,690,269	-----	29,002,298	44,844,675	73,846,973
1956	15,874,652	21,064,574	115,985	37,052,211	20,322,775	57,377,986
1957	22,613,429	20,911,816	-----	43,525,245	39,564,027	83,089,272
1958	25,387,036	724,753	1,075,988	27,187,777	27,485,321	54,673,098
1959	32,522,331	-----	218,133	32,740,464	29,741,982	62,482,446
1960	32,056,980	2,986,543	69,104	35,112,627	36,339,548	71,452,175
1961	20,594,360	8,385,175	143,709	29,123,244	30,291,007	59,414,251
Total	550,701,134	273,506,359	7,670,485	831,877,978	420,308,915	1,252,186,893

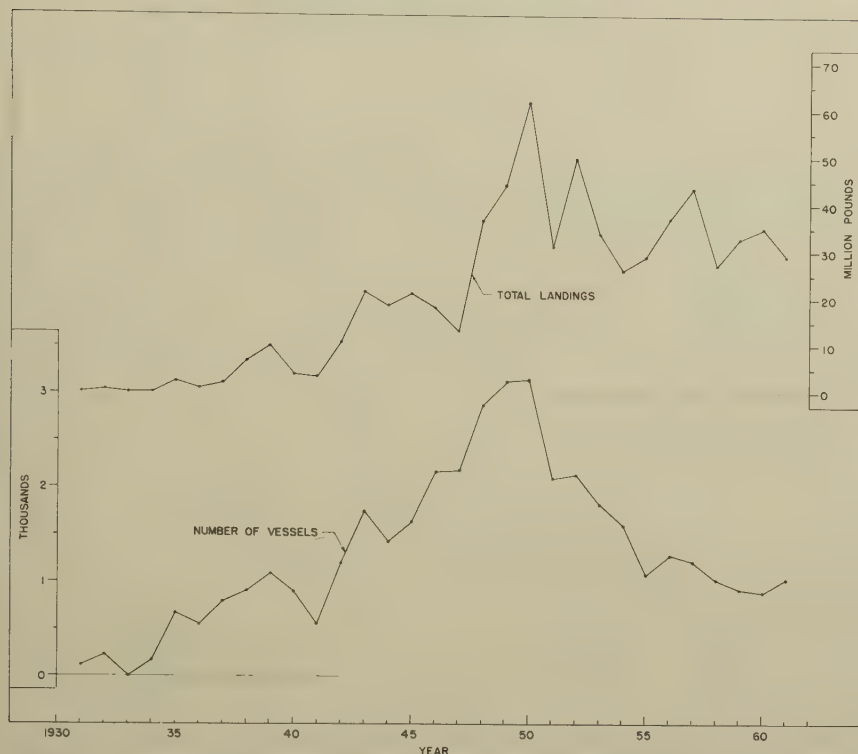


FIGURE 17. Number of commercial vessels participating in the California albacore fishery, compared to the landings (1931 through 1961).

COLD-WATER SEASONS: 1951-1956

(Figures 18 through 61)

Description of the Months

A meaningful discussion of this cool regime requires that we first synthesize "typical" months from the data to illustrate events that took place during these six seasons:

June (Figures 18, 24, 31, 37, 44 and 52): Fishing occurred below Point Arguello from Asuncion Bay, Baja California, to Santa Cruz Island, California and offshore some 250 miles. This is a south-north distance exceeding 400 miles. Despite a significant amount of effort spent scouting for the early albacore schools, total fishing pressure remained comparatively light, and catches were small, sporadic, and fairly well scattered. The ocean-spanning eastward migration was well underway, and although large numbers of incoming schools had not yet appeared, the migration leaders had entered the southern part of our grounds—below Guadalupe Island.

July (Figures 19, 25, 32, 38, 45 and 53): The season's first heavy catches were realized as the main body of transpacific migrants arrived and concentrated within reach of the fleet. Total scouting and fishing days increased rapidly, and the grounds extended 300 miles offshore and some 500 miles along the coast from Abreojos Point, Baja California, to Point Arguello, California. Many captains from Washington, Oregon, and northern California trolled southward enroute toward the main fishing area, but they found few albacore north of Point Arguello.

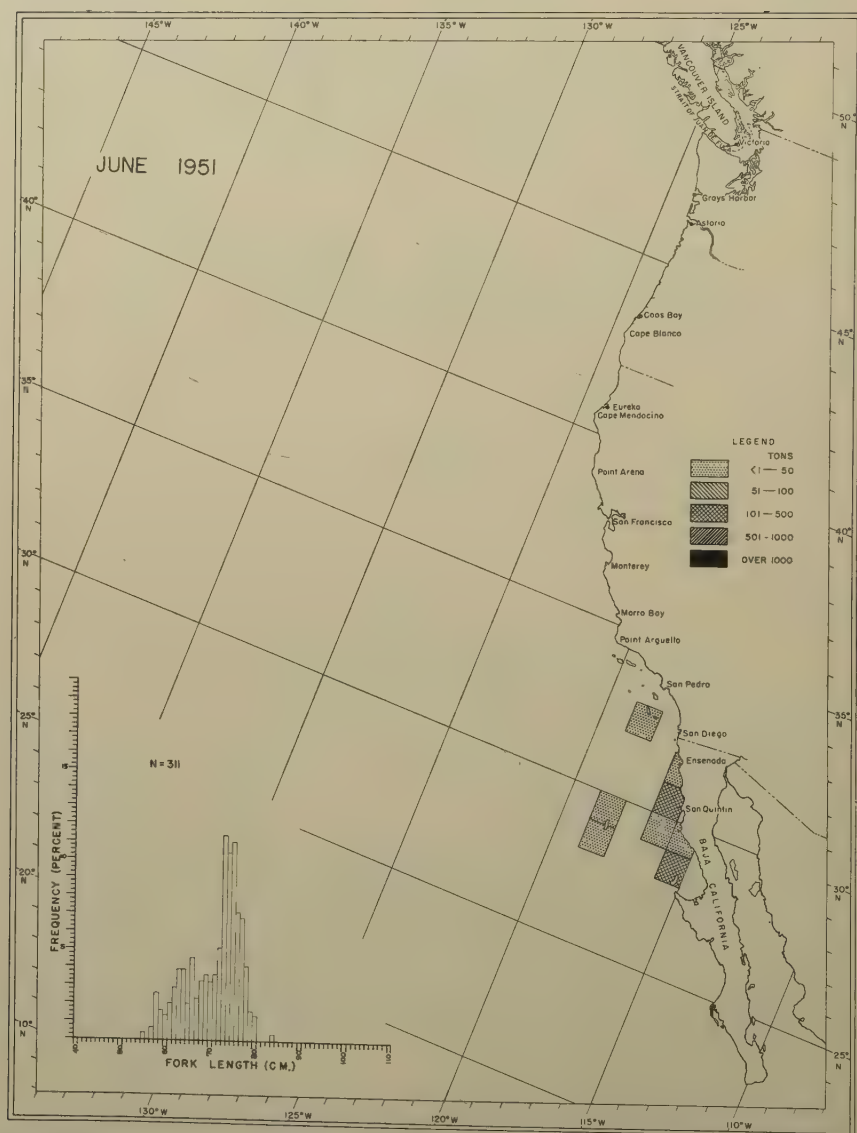


FIGURE 18. Albatross catch localities by one-degree squares for the California commercial fleet. Appendix E. Insert shows the length frequencies.

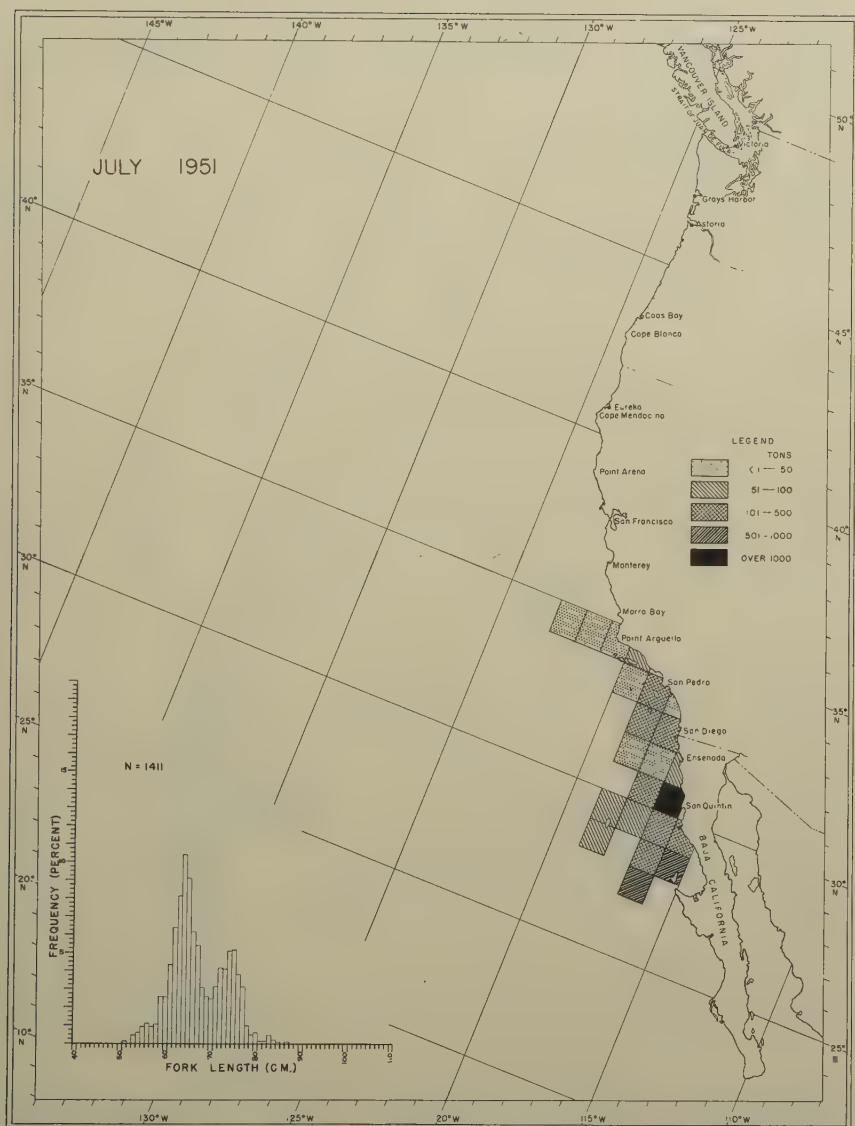


FIGURE 19. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

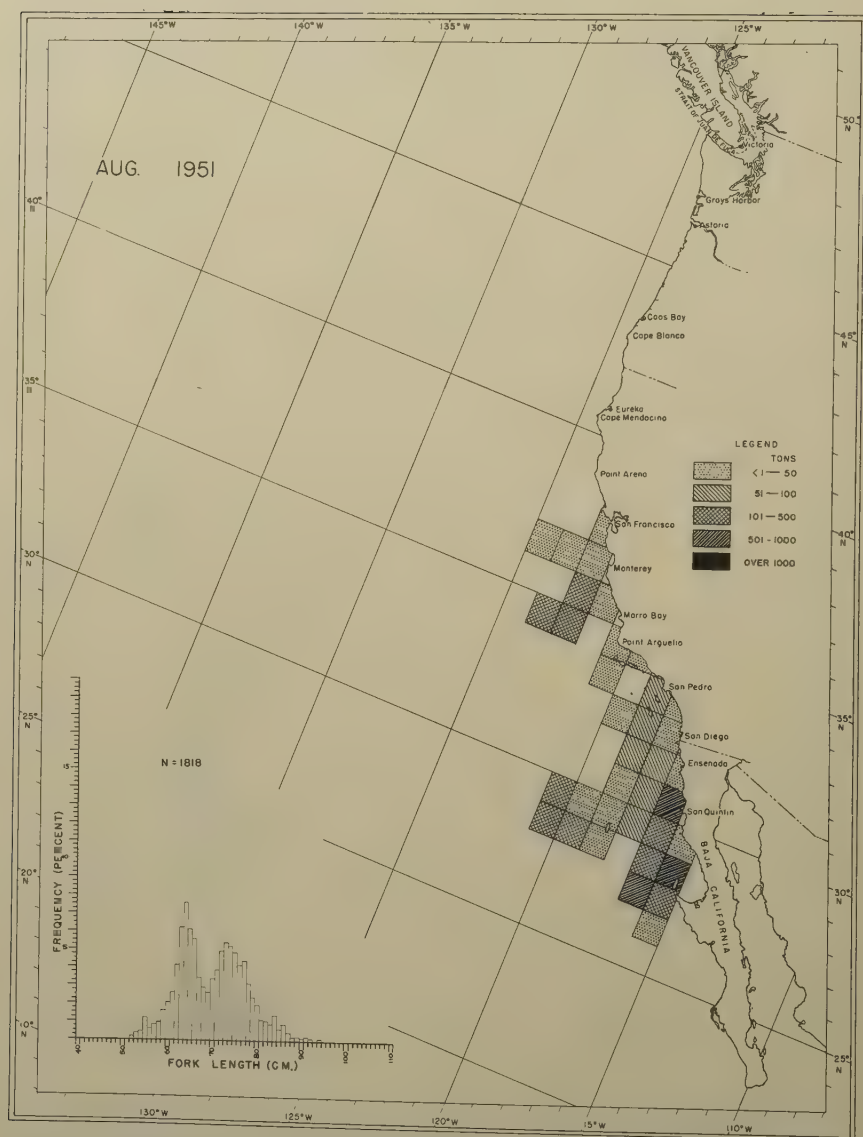


FIGURE 20. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

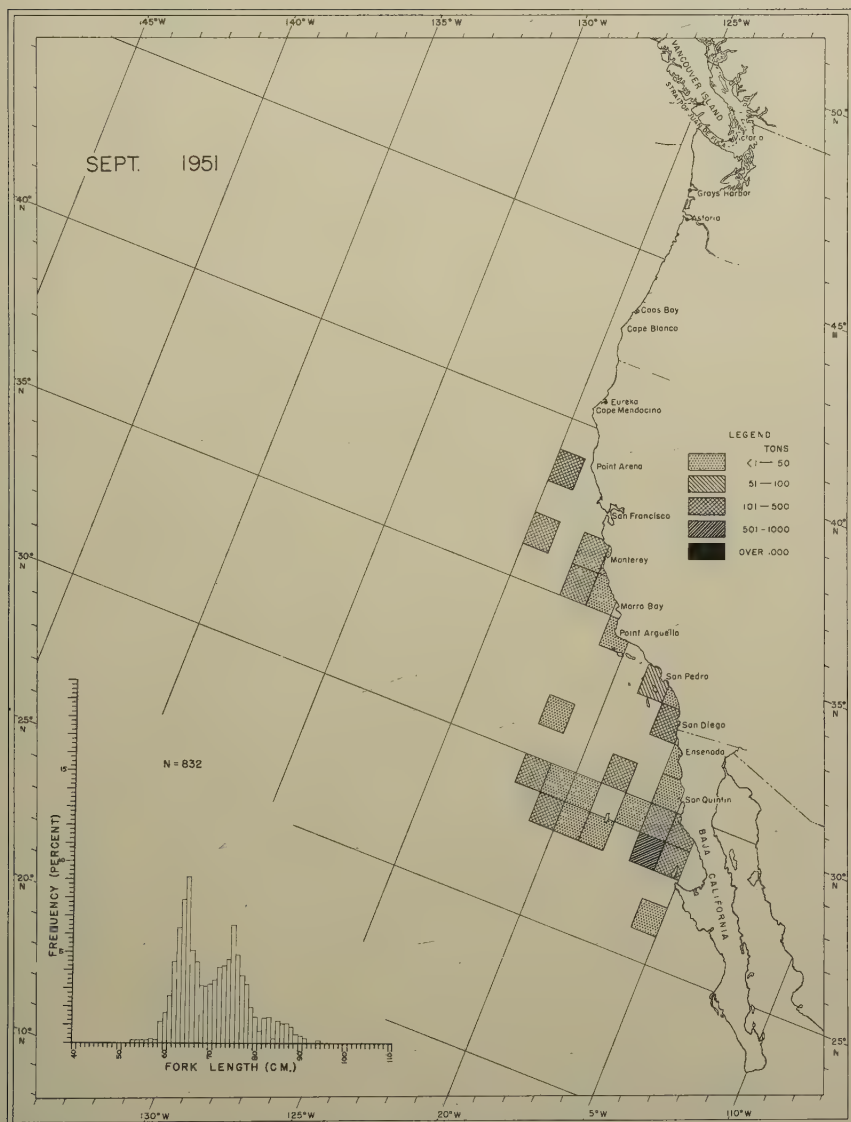


FIGURE 21. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

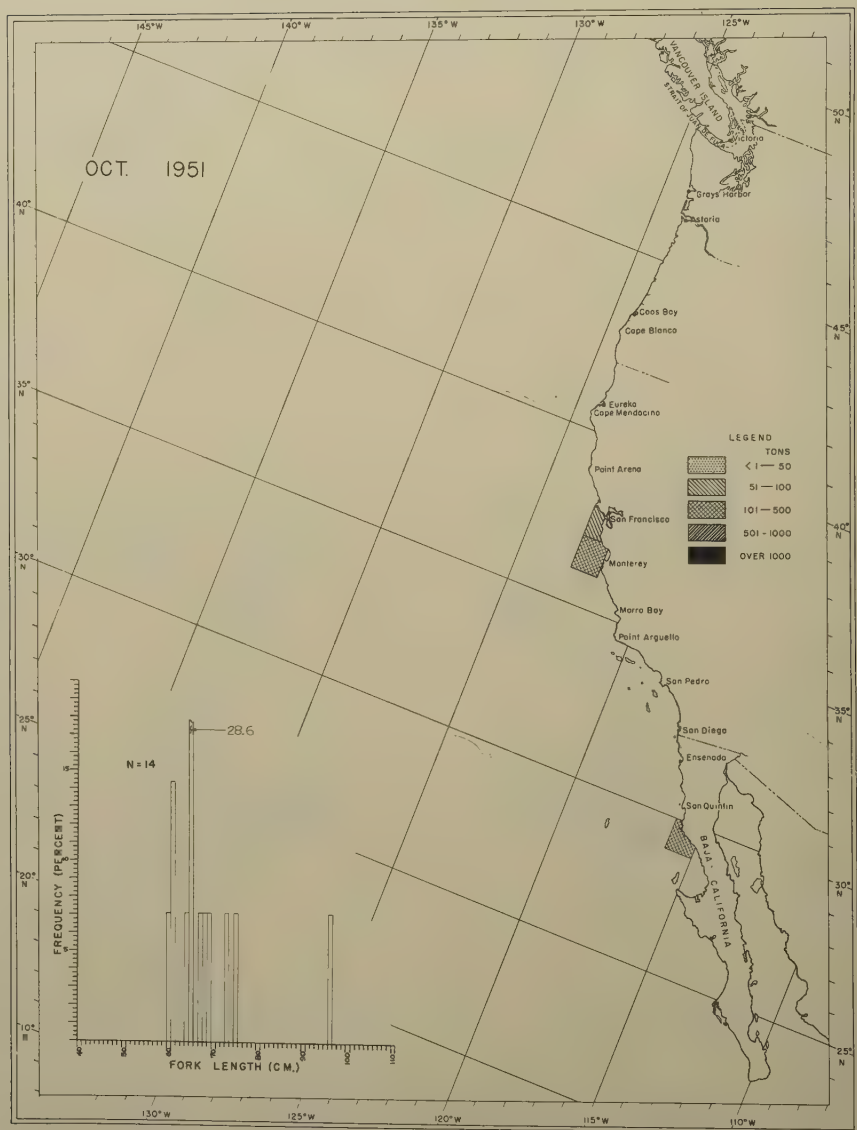


FIGURE 22. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

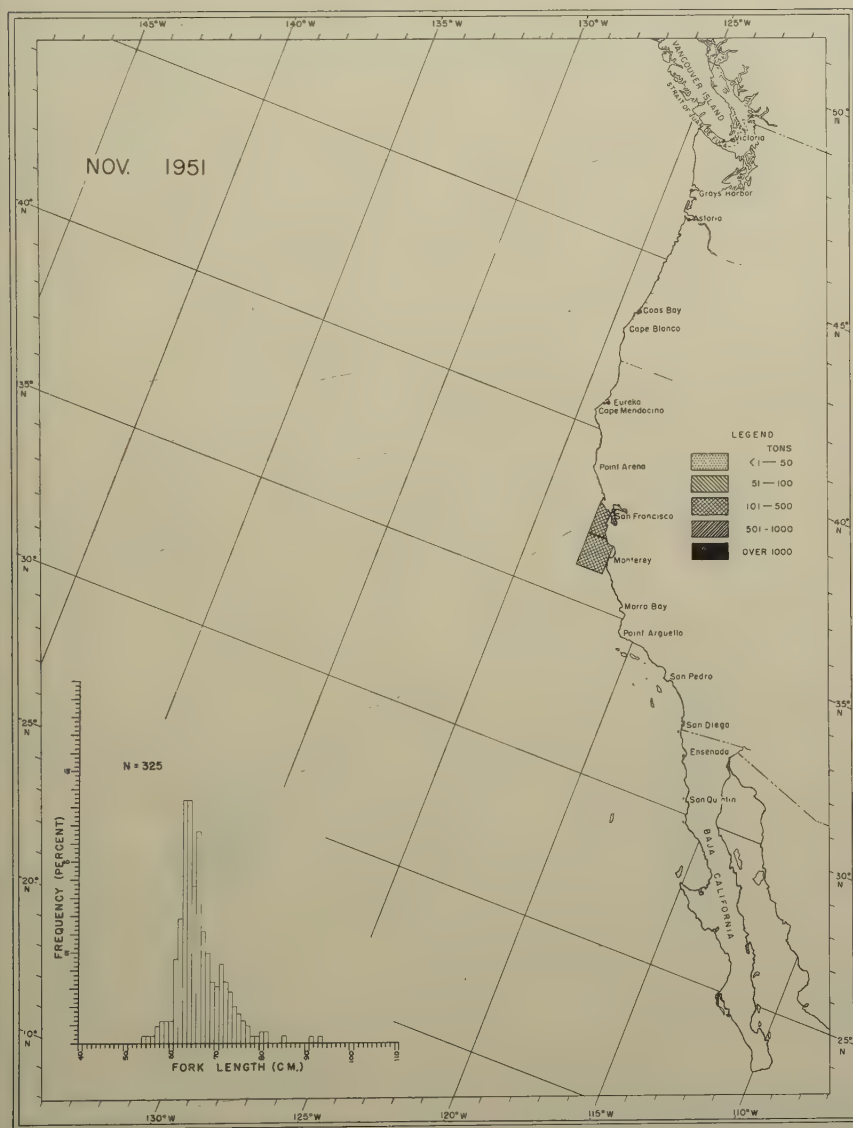


FIGURE 23. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

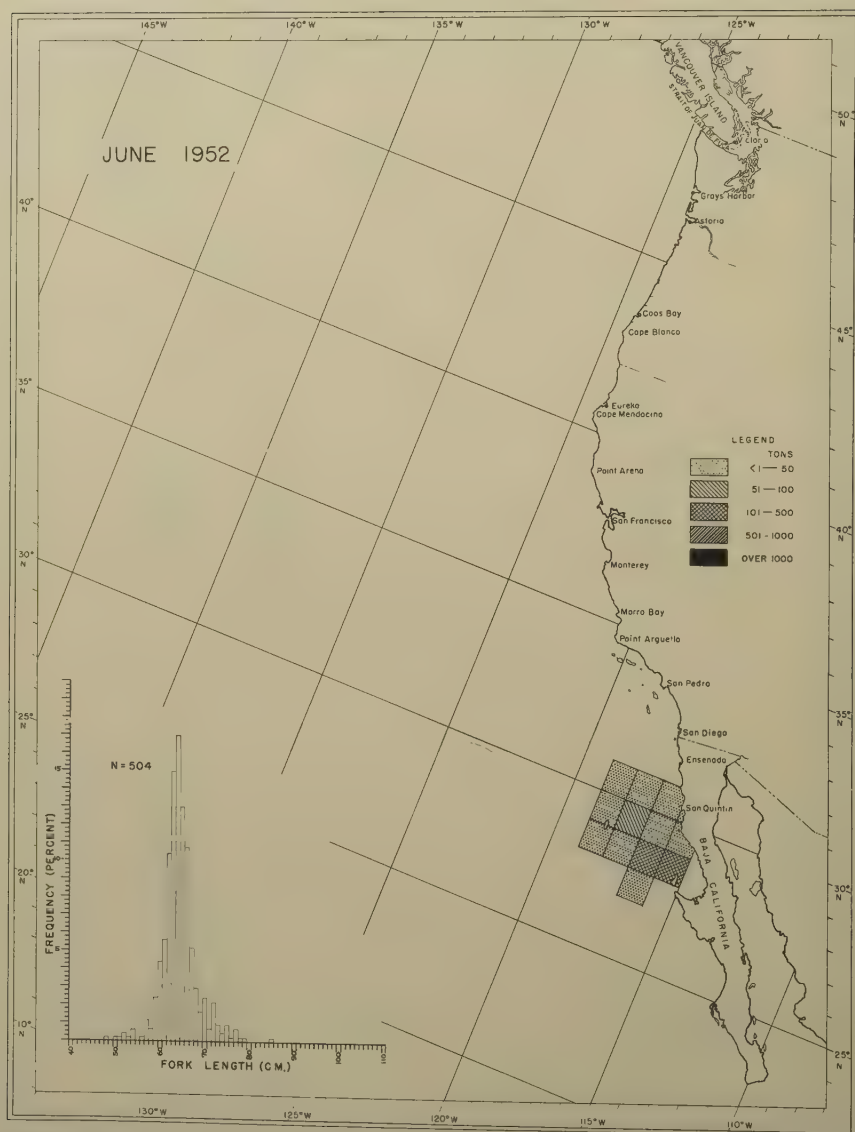


FIGURE 24. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

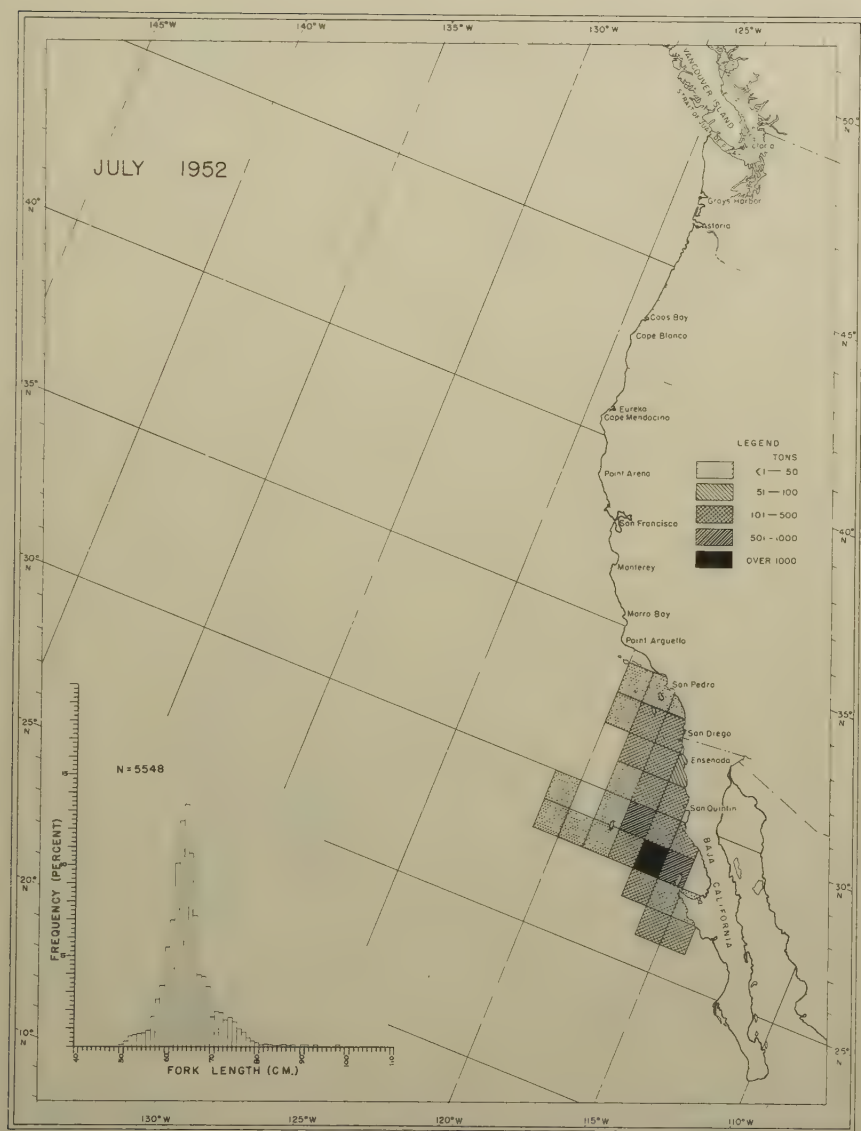


FIGURE 25. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

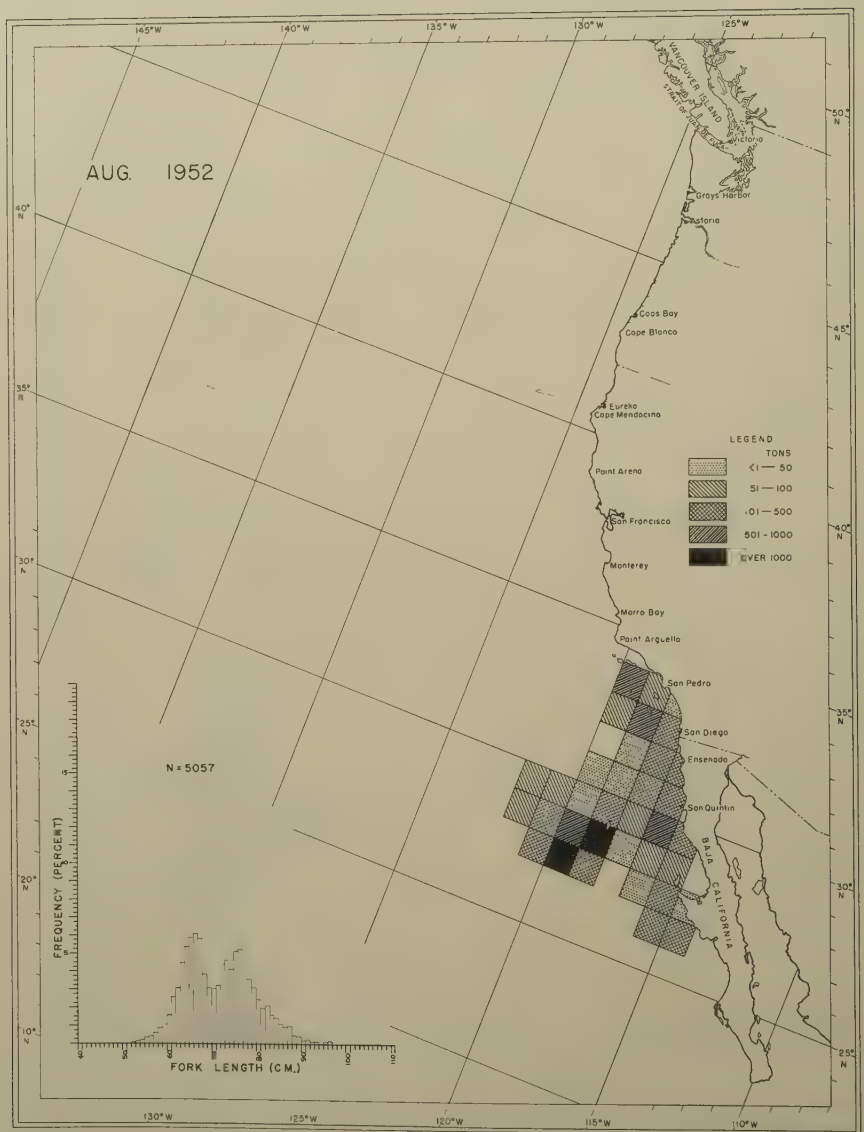


FIGURE 26. Albatross catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

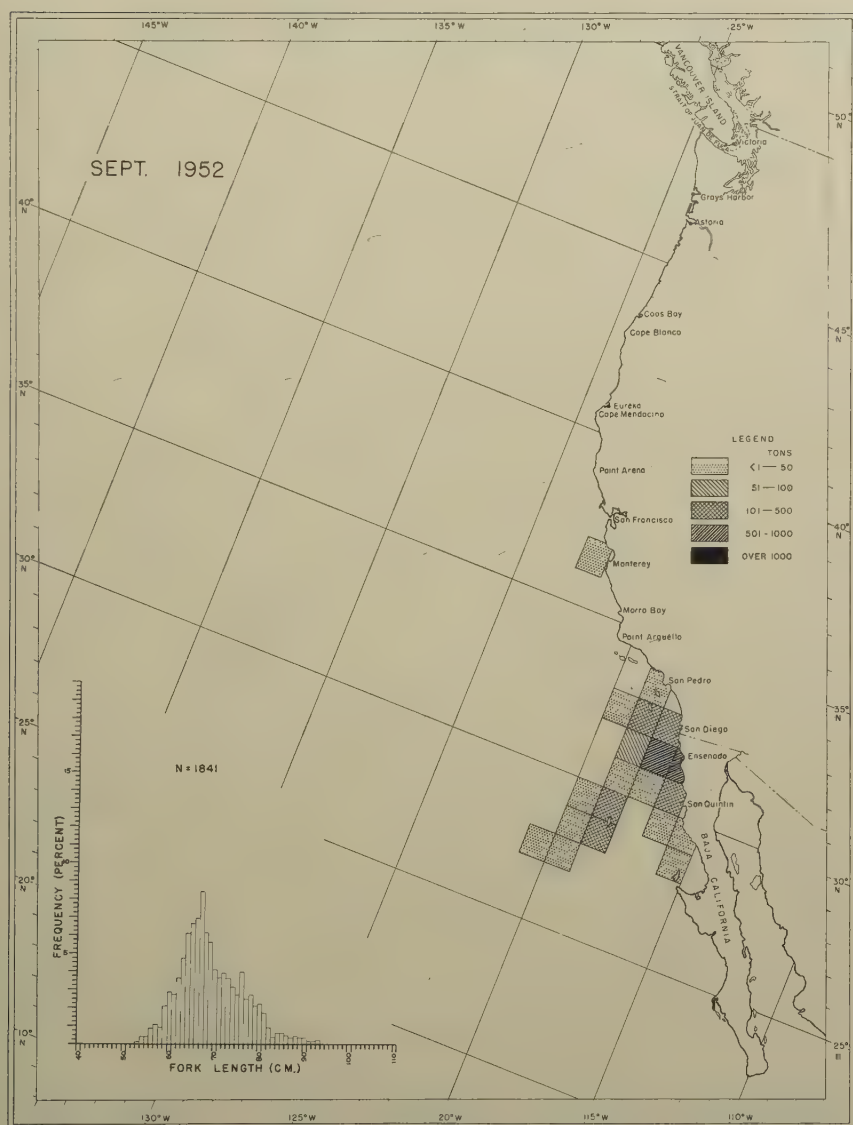


FIGURE 27. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

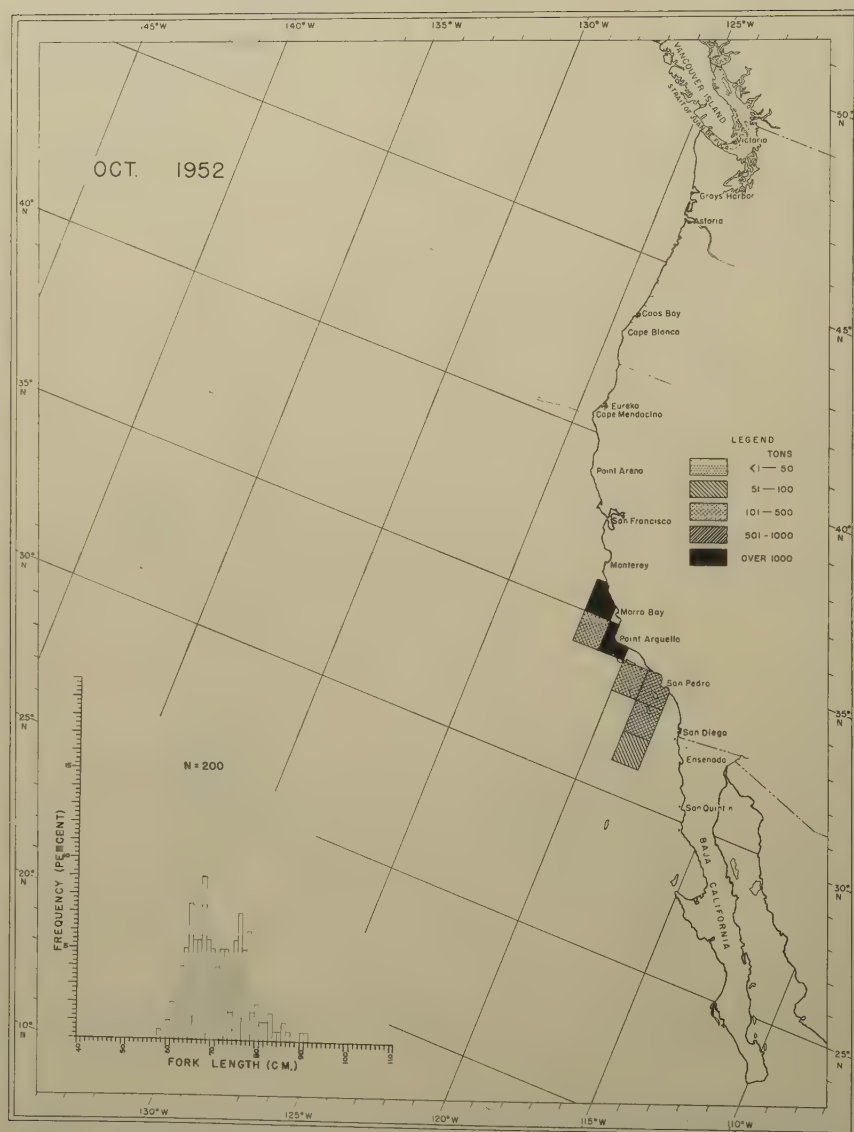


FIGURE 28. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

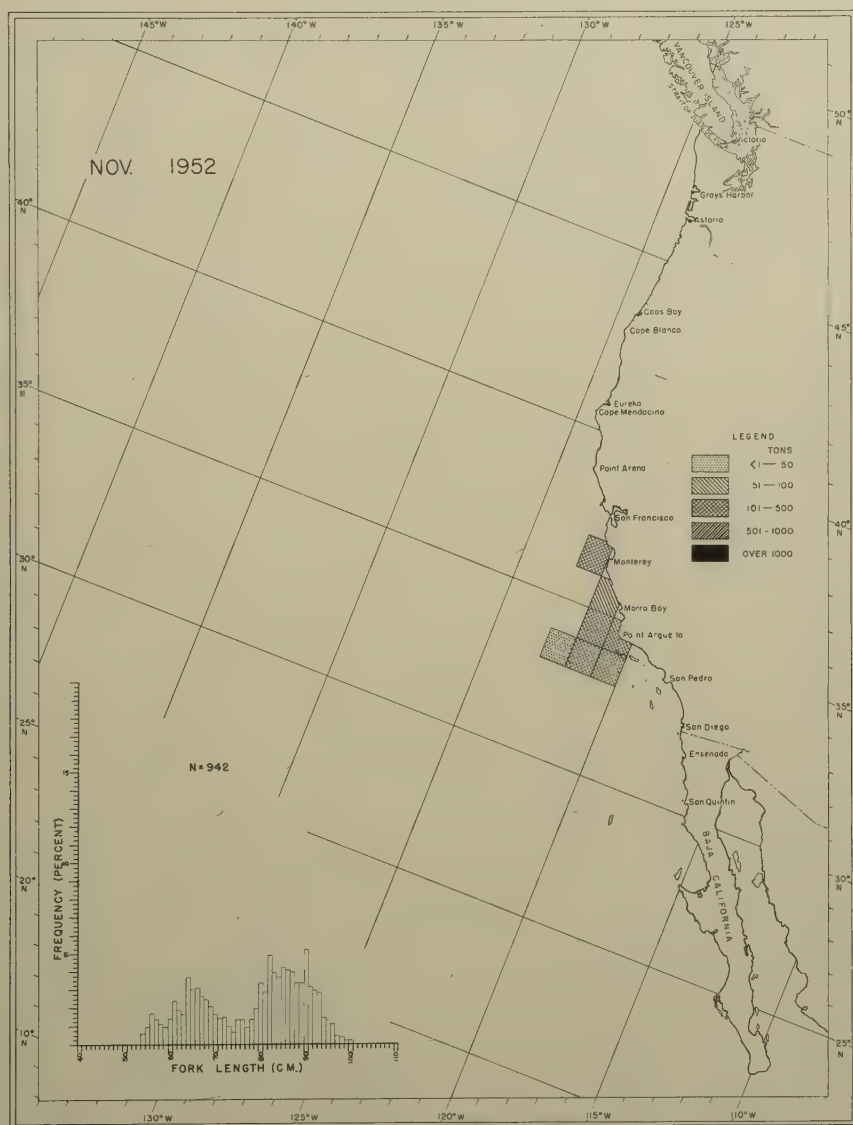


FIGURE 29. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

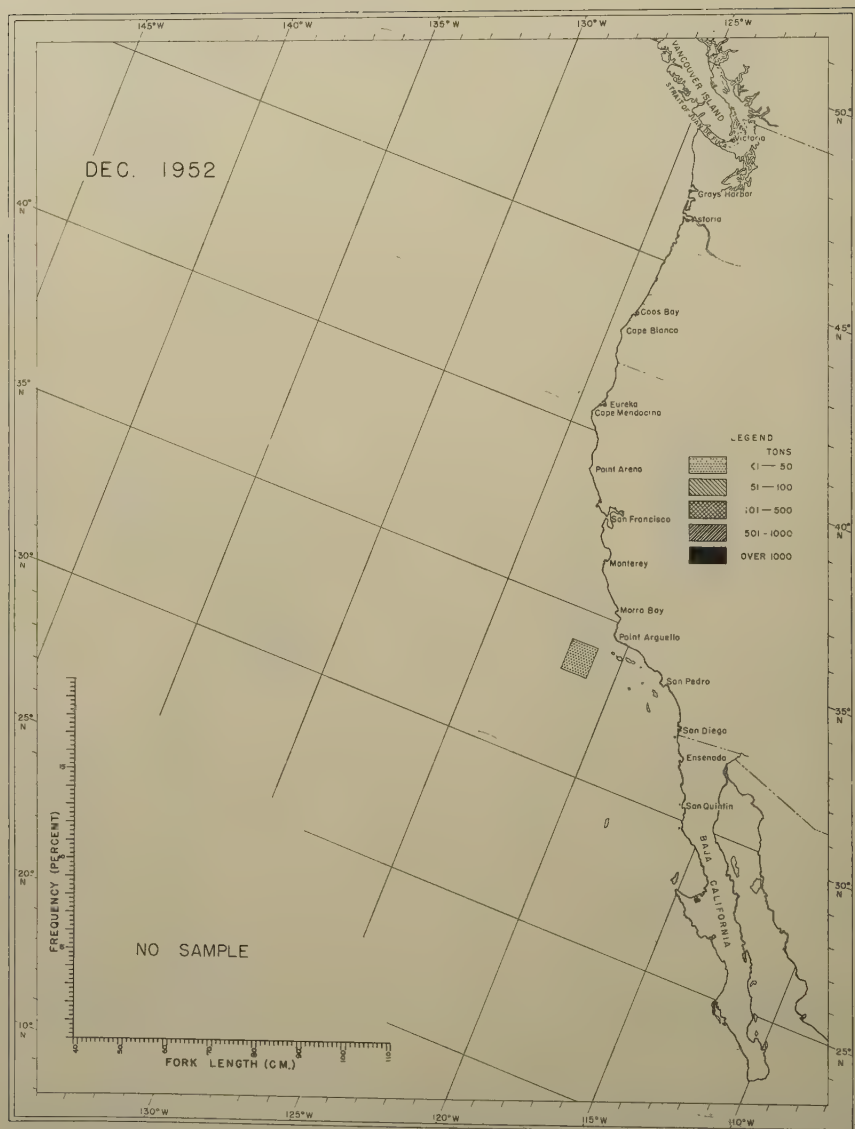


FIGURE 30. Albatross catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

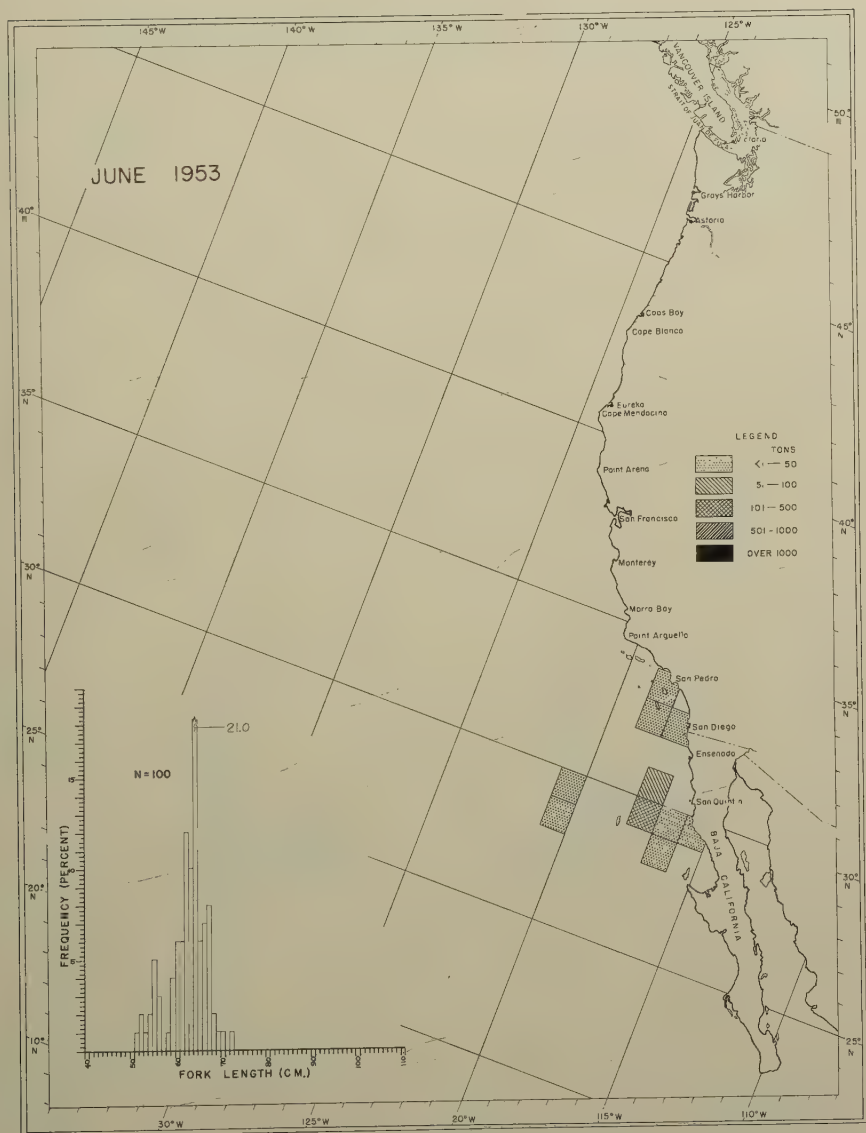


FIGURE 31. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

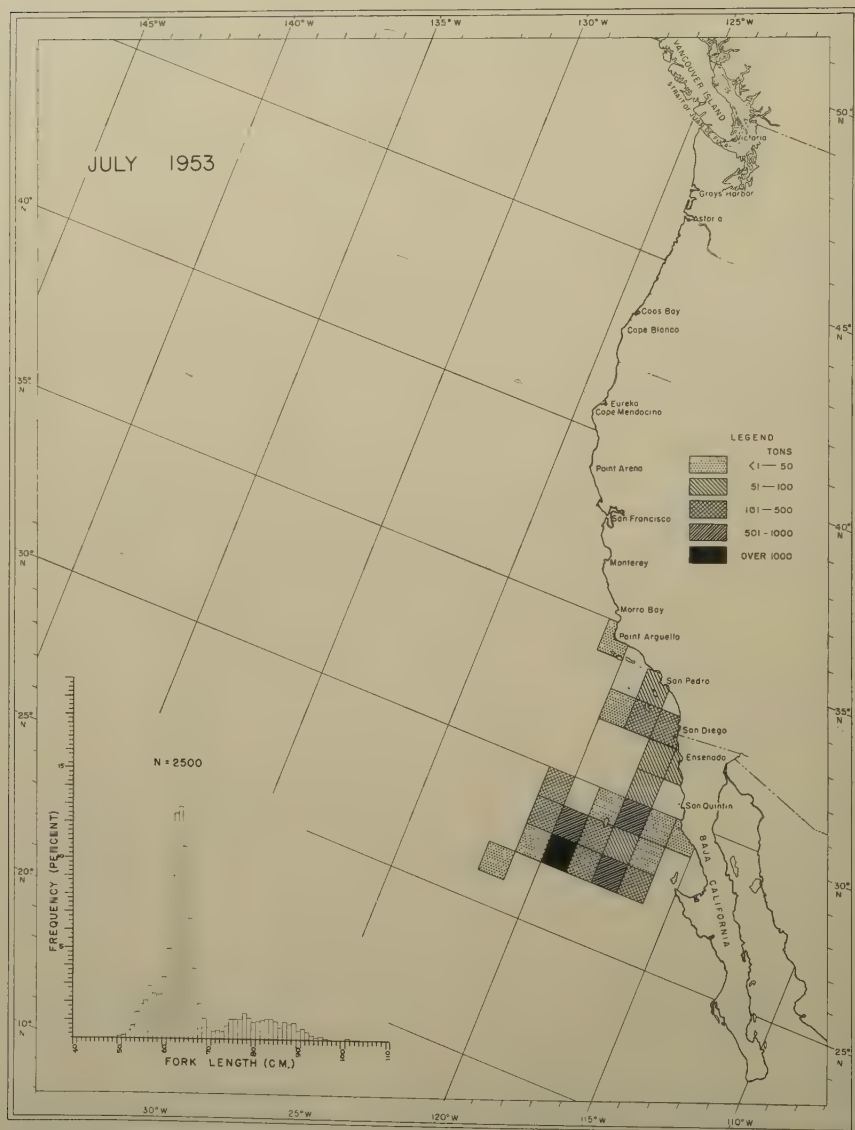


FIGURE 32. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

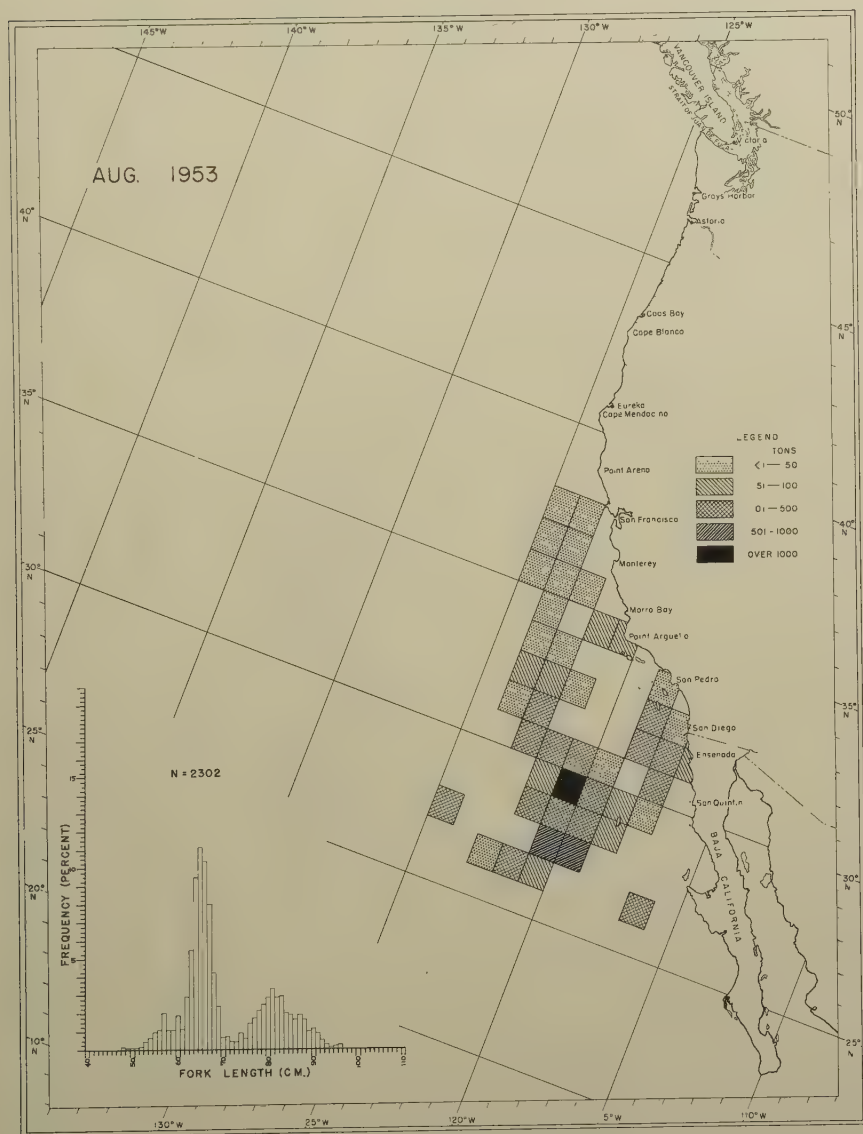


FIGURE 33. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

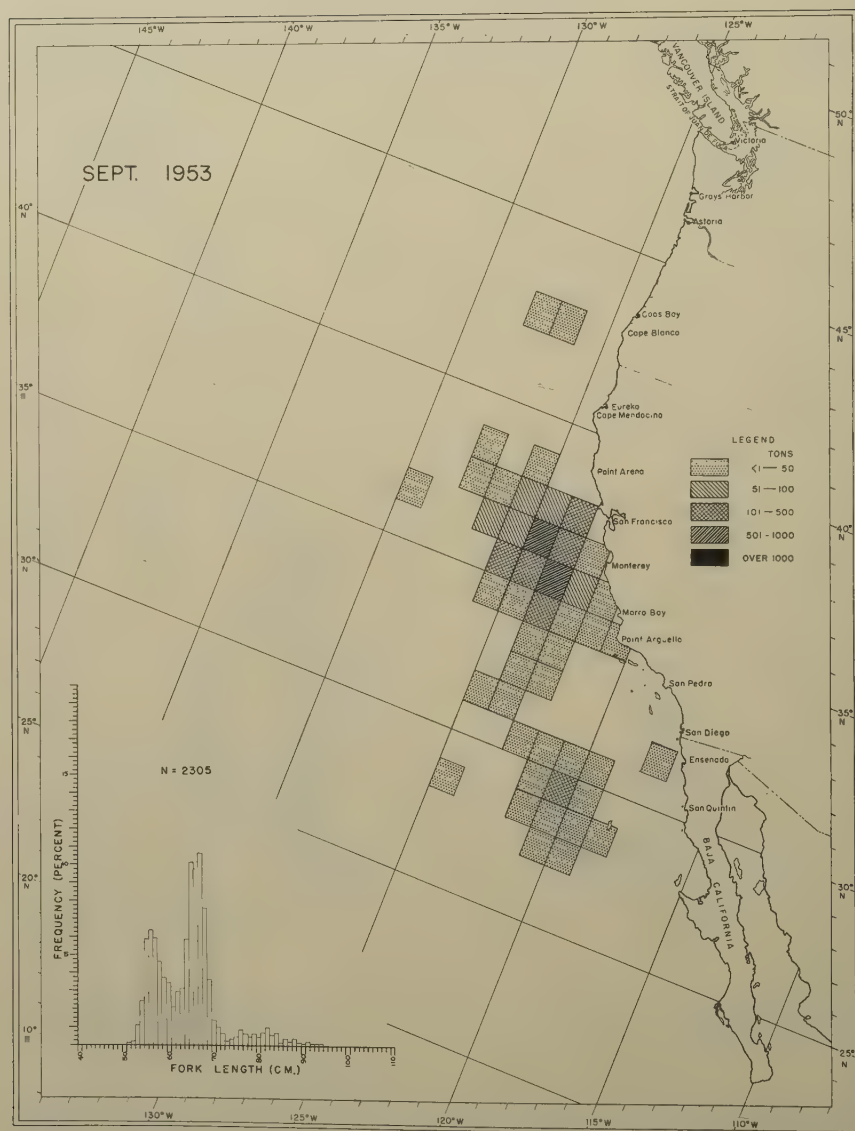


FIGURE 34. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

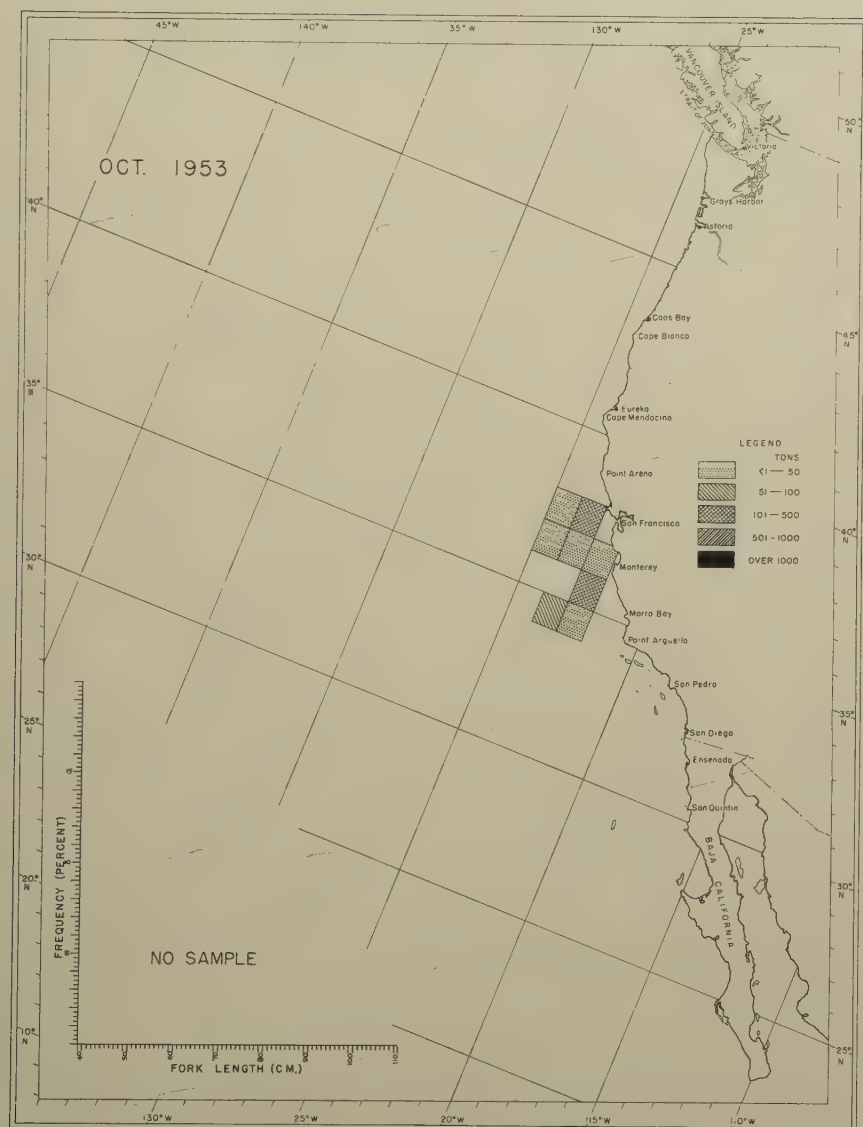


FIGURE 35. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

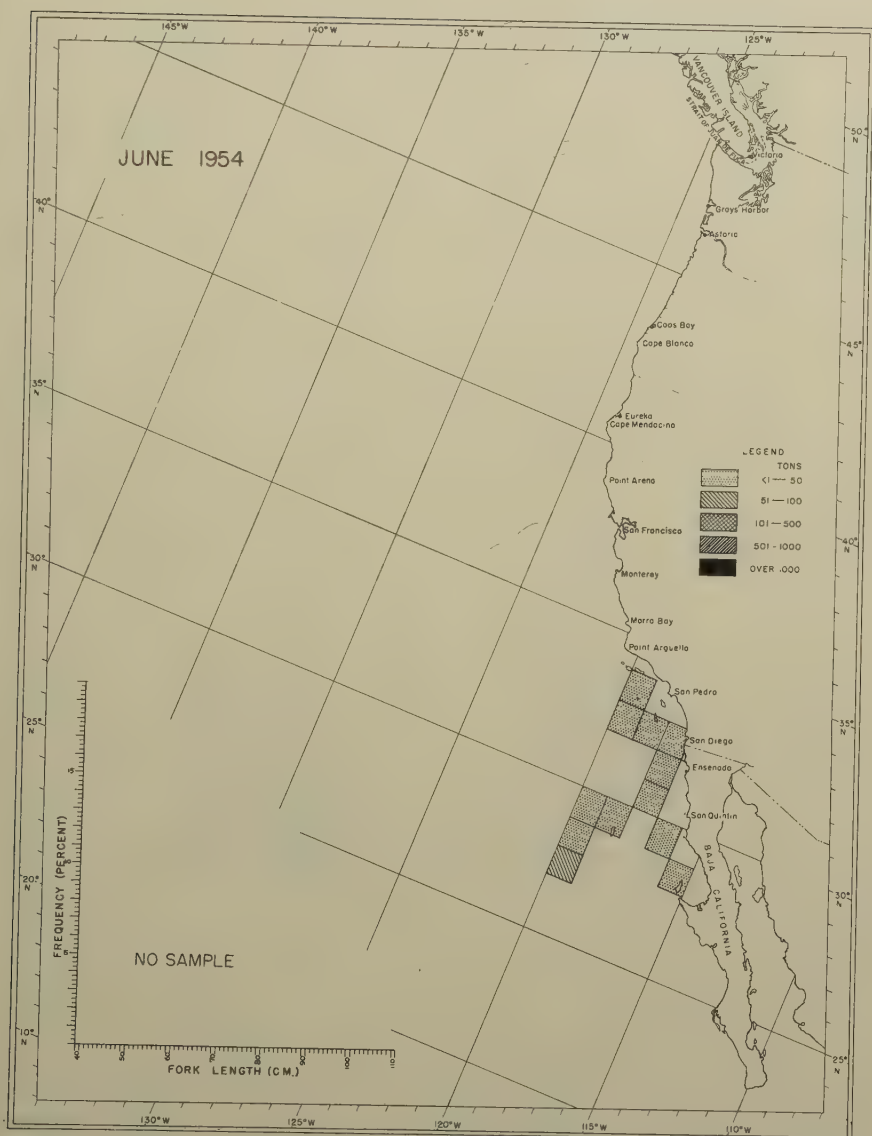


FIGURE 37. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

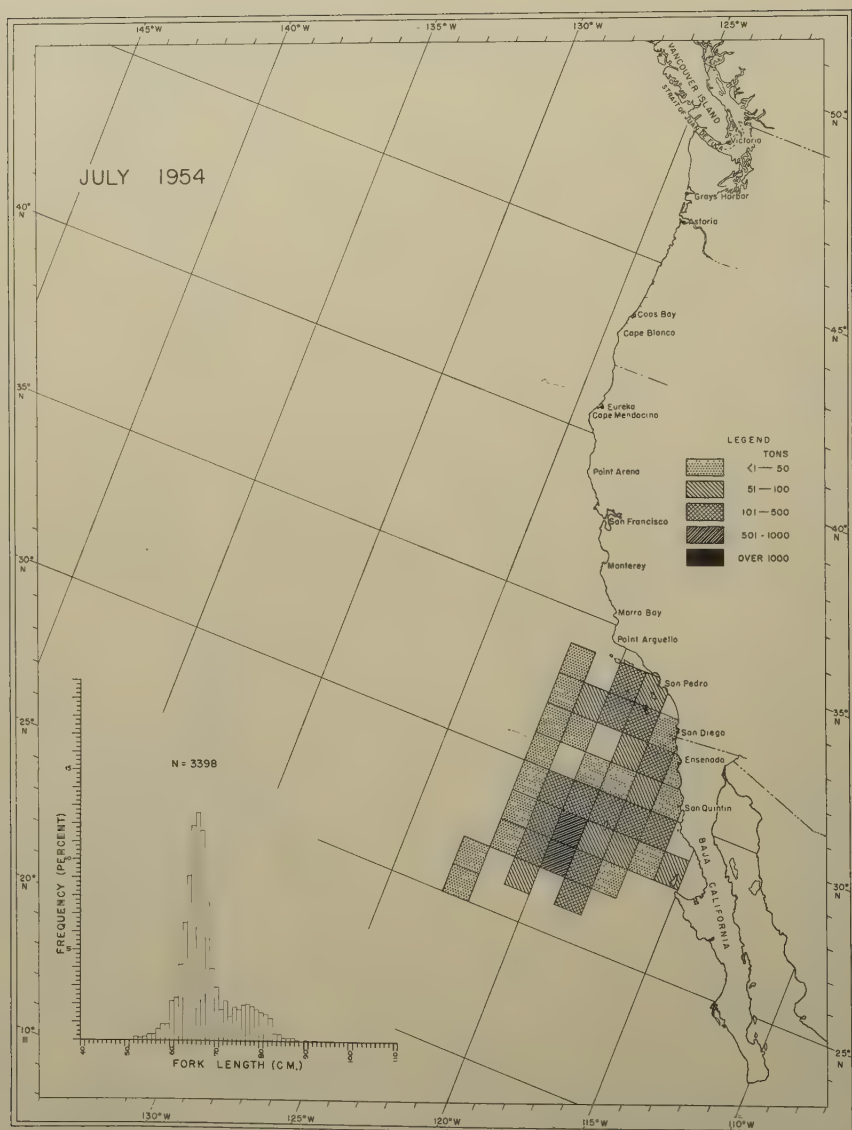


FIGURE 38. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

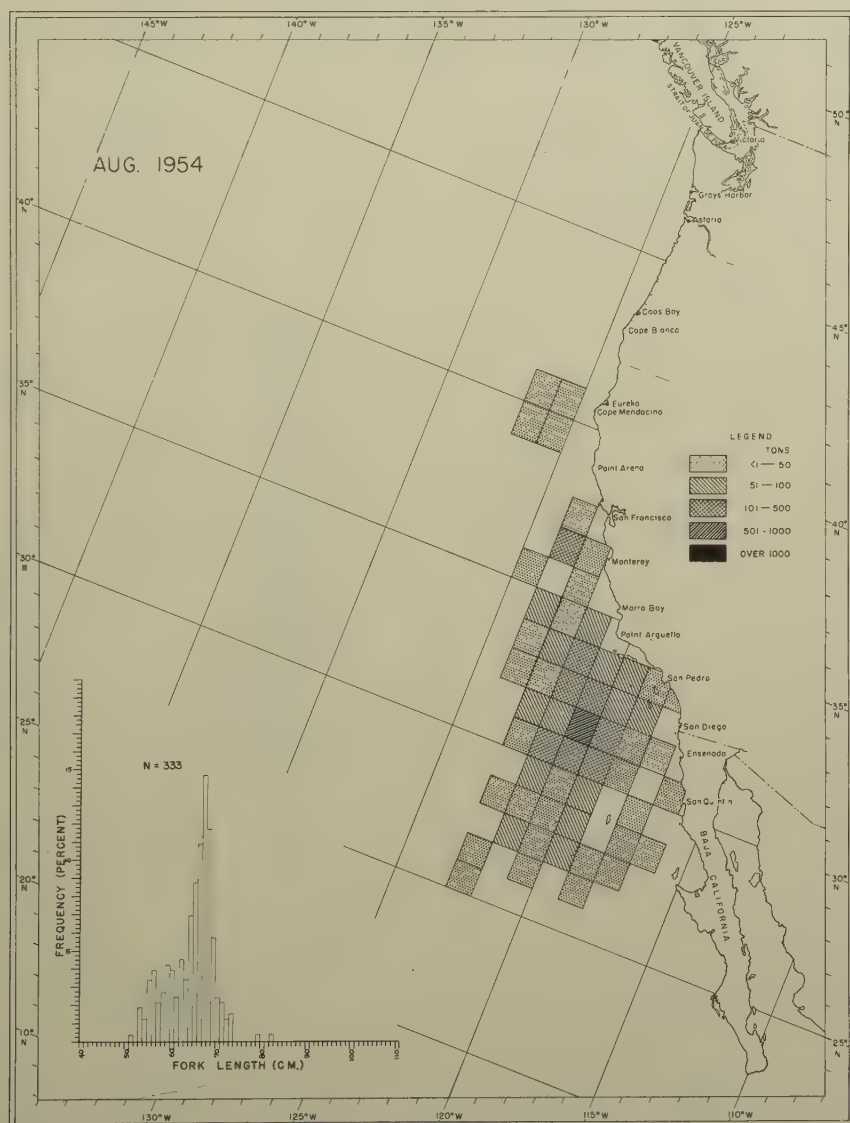


FIGURE 39. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

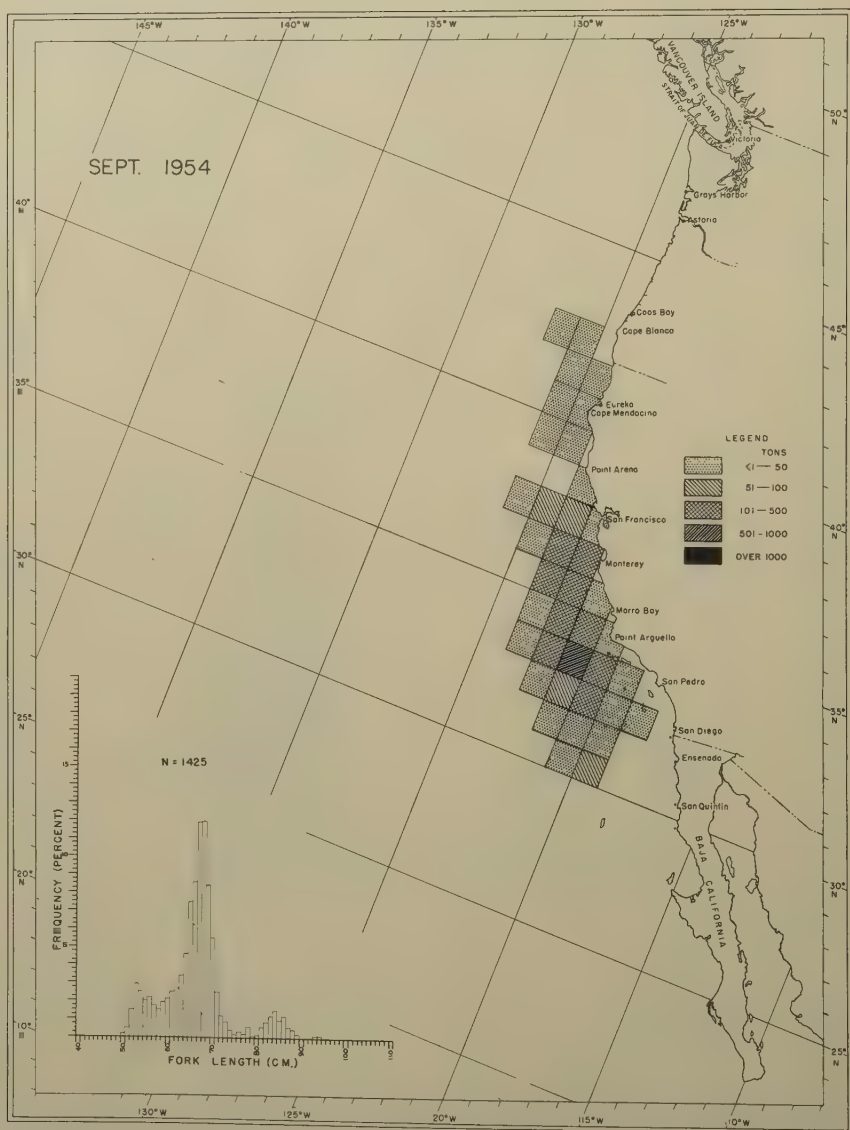


FIGURE 40. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

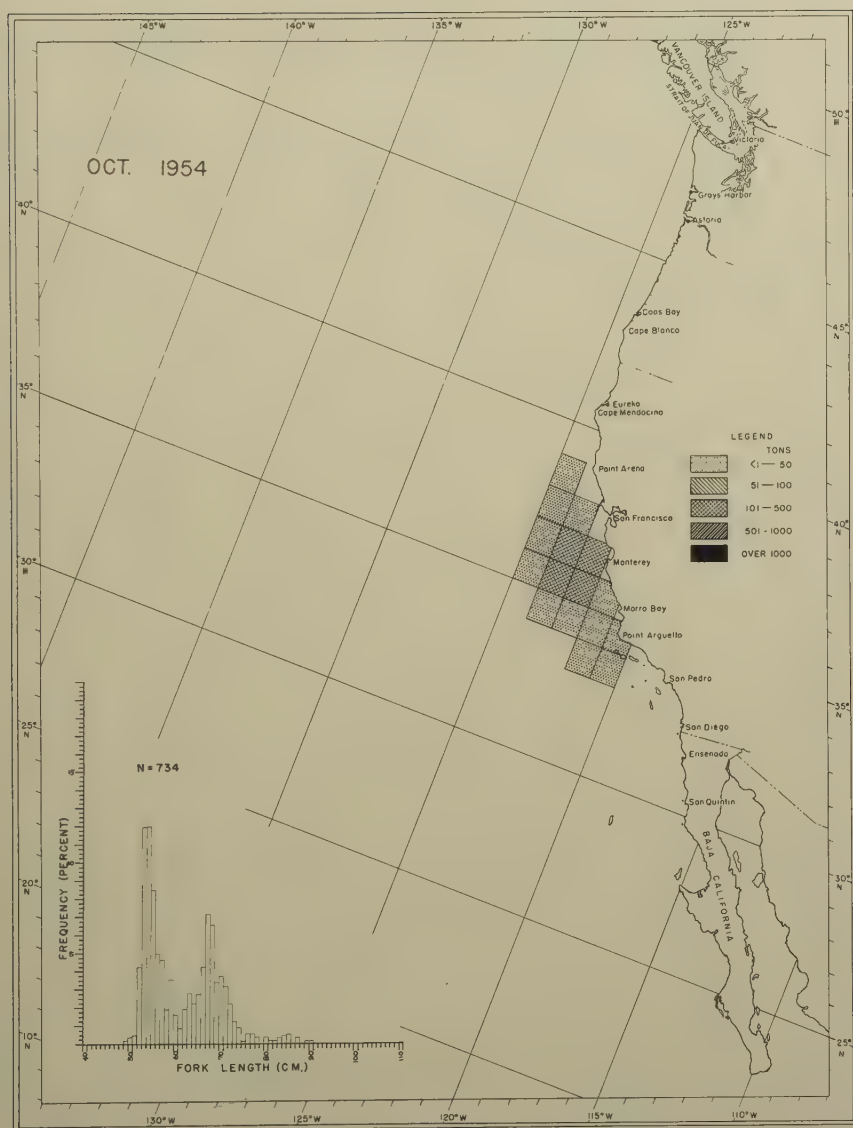


FIGURE 41. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

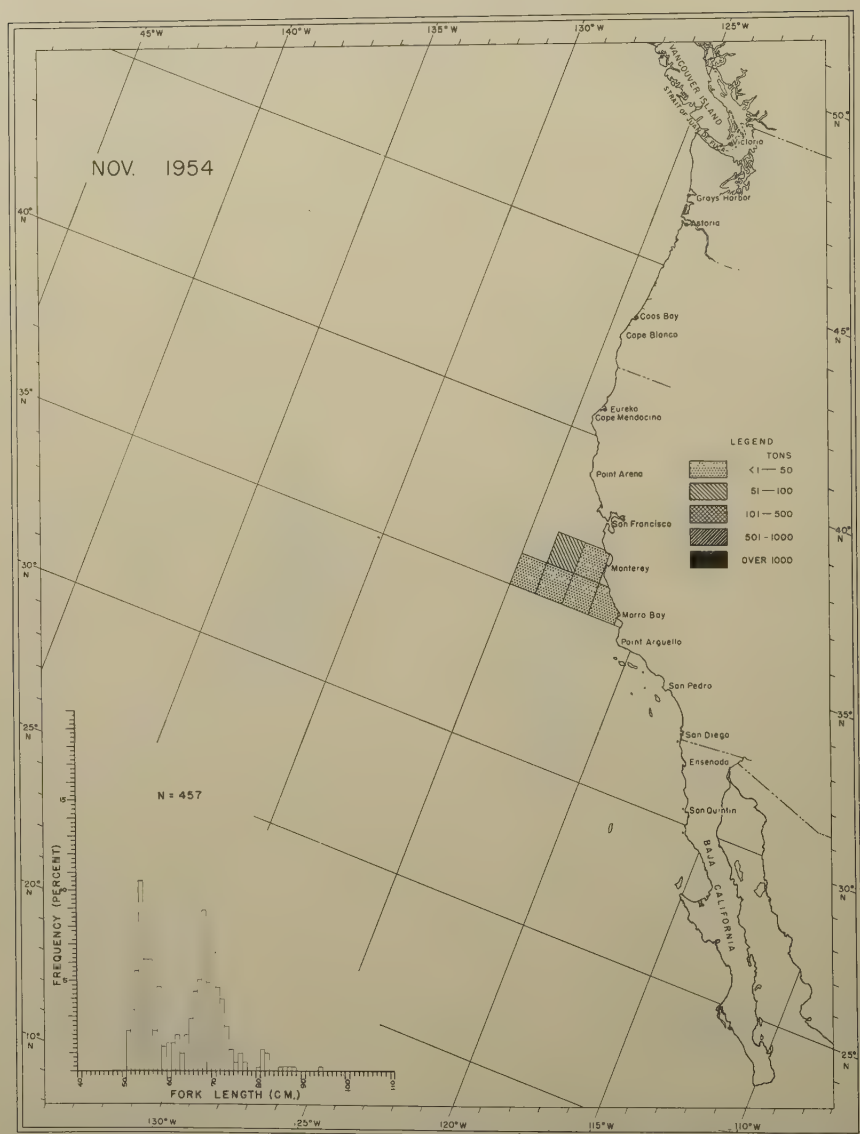


FIGURE 42. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

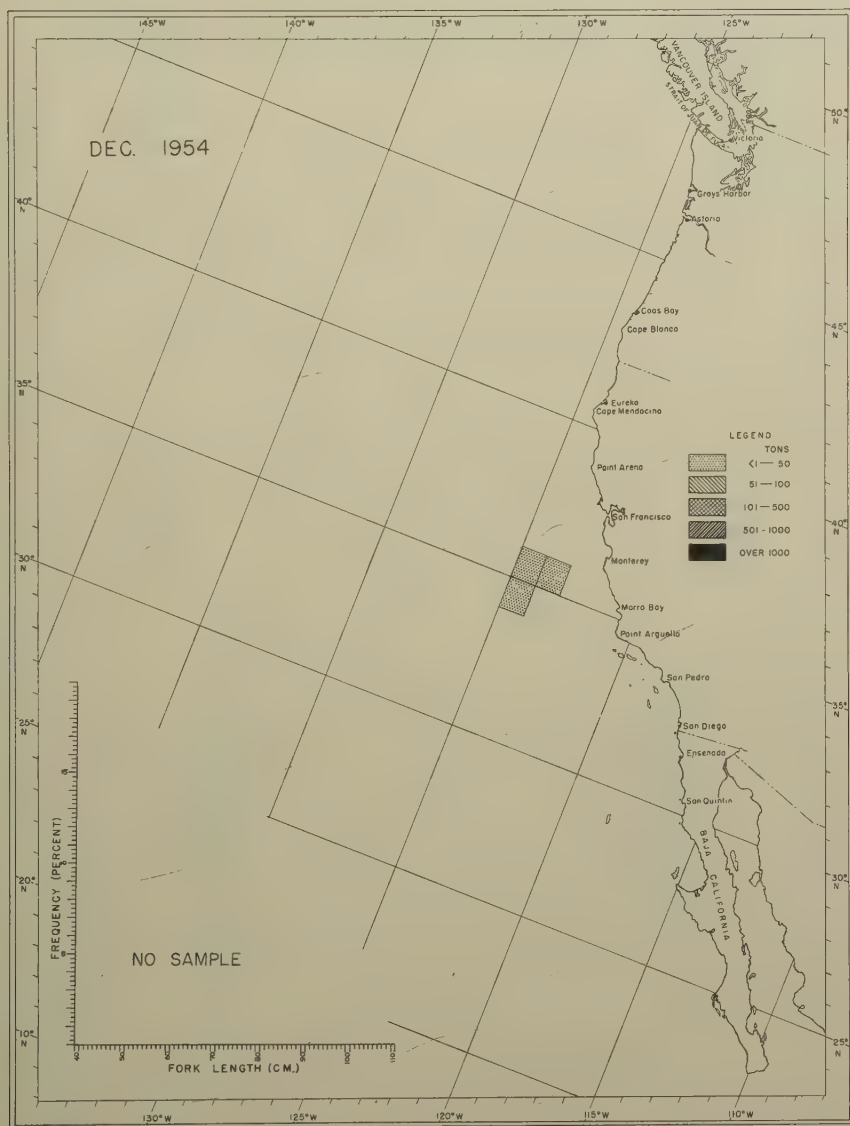


FIGURE 43. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

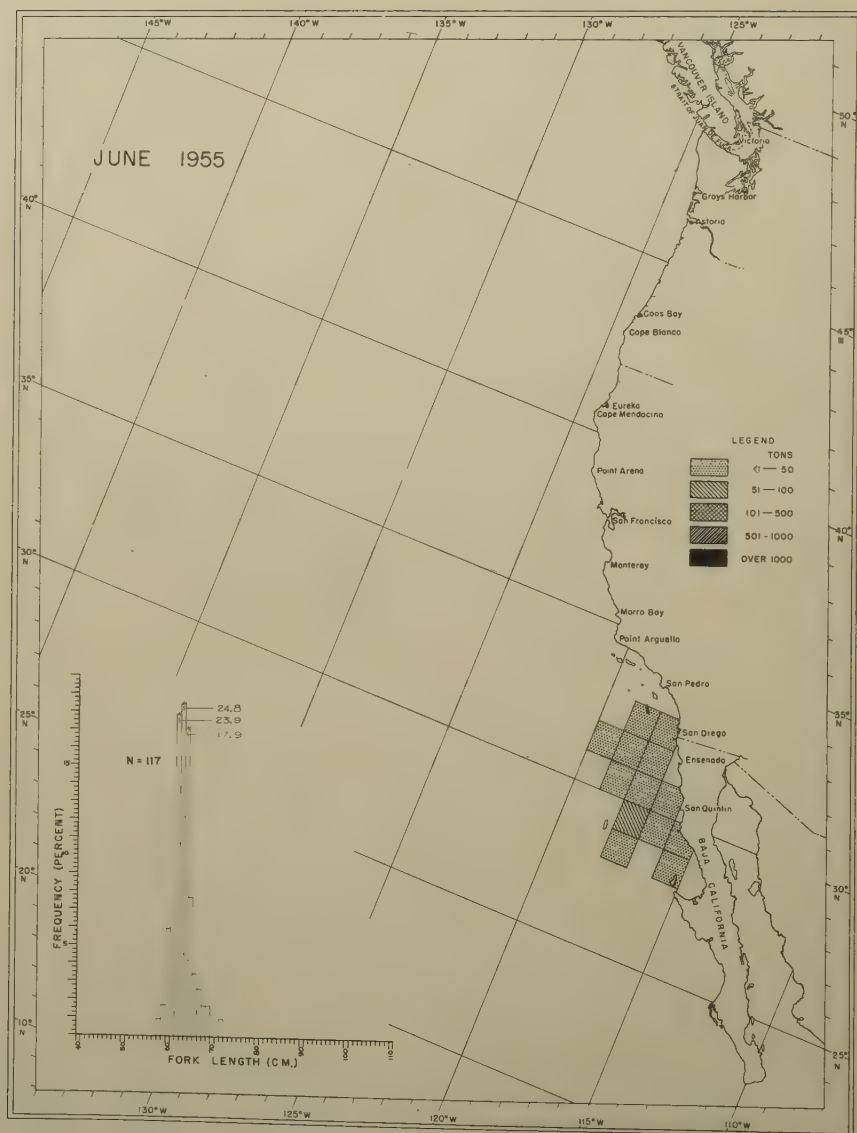


FIGURE 44. Albatross catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

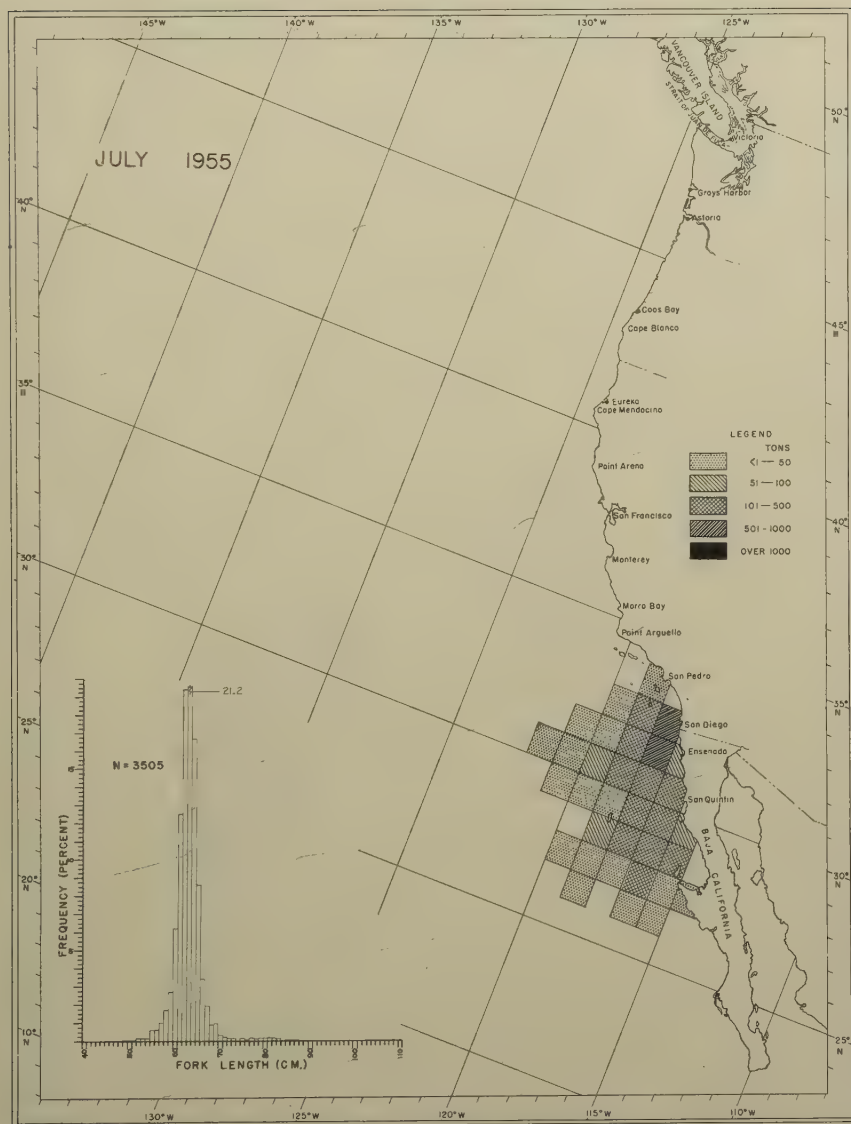
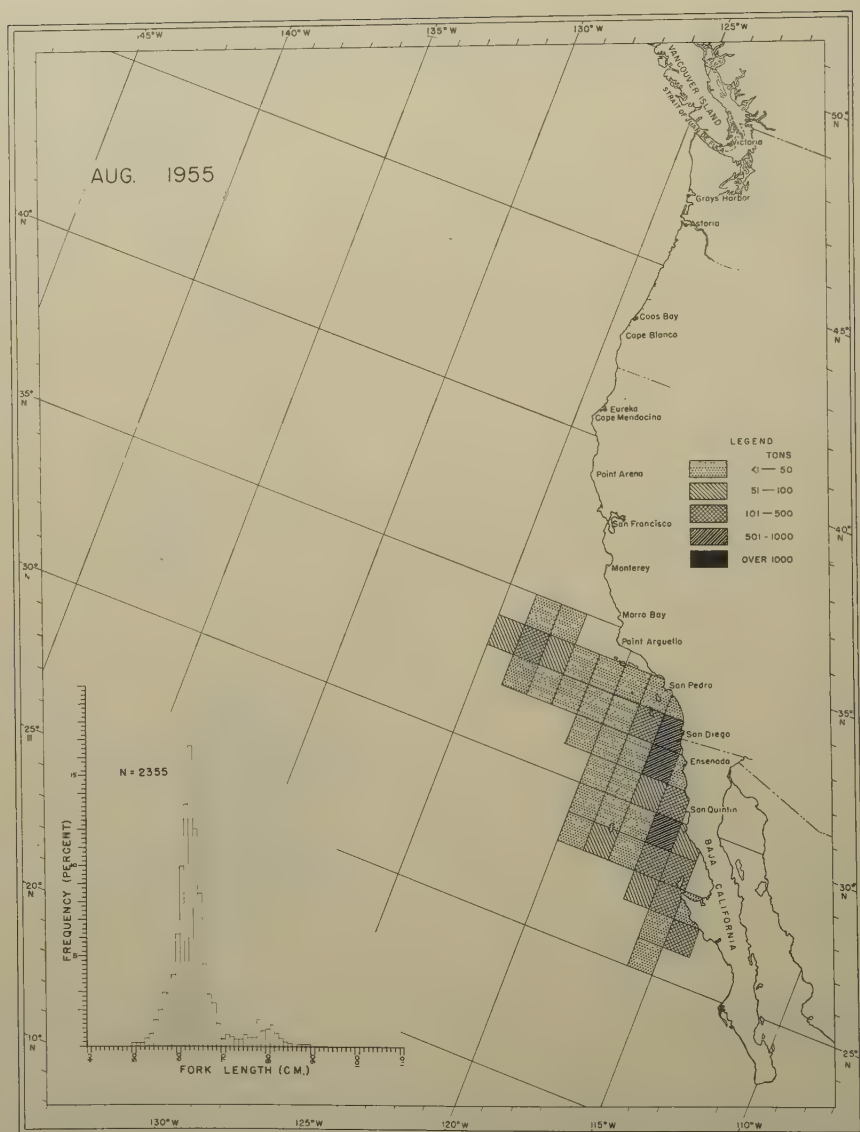


FIGURE 45. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.



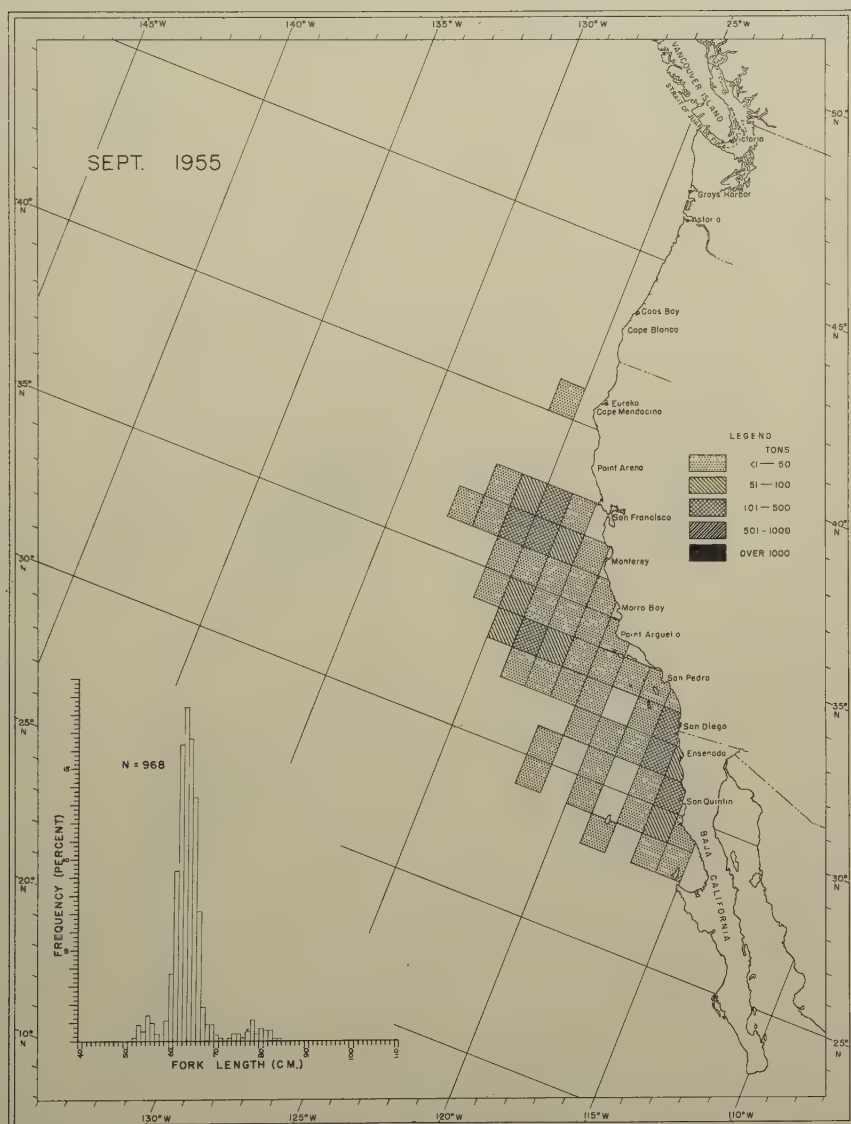


FIGURE 47. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

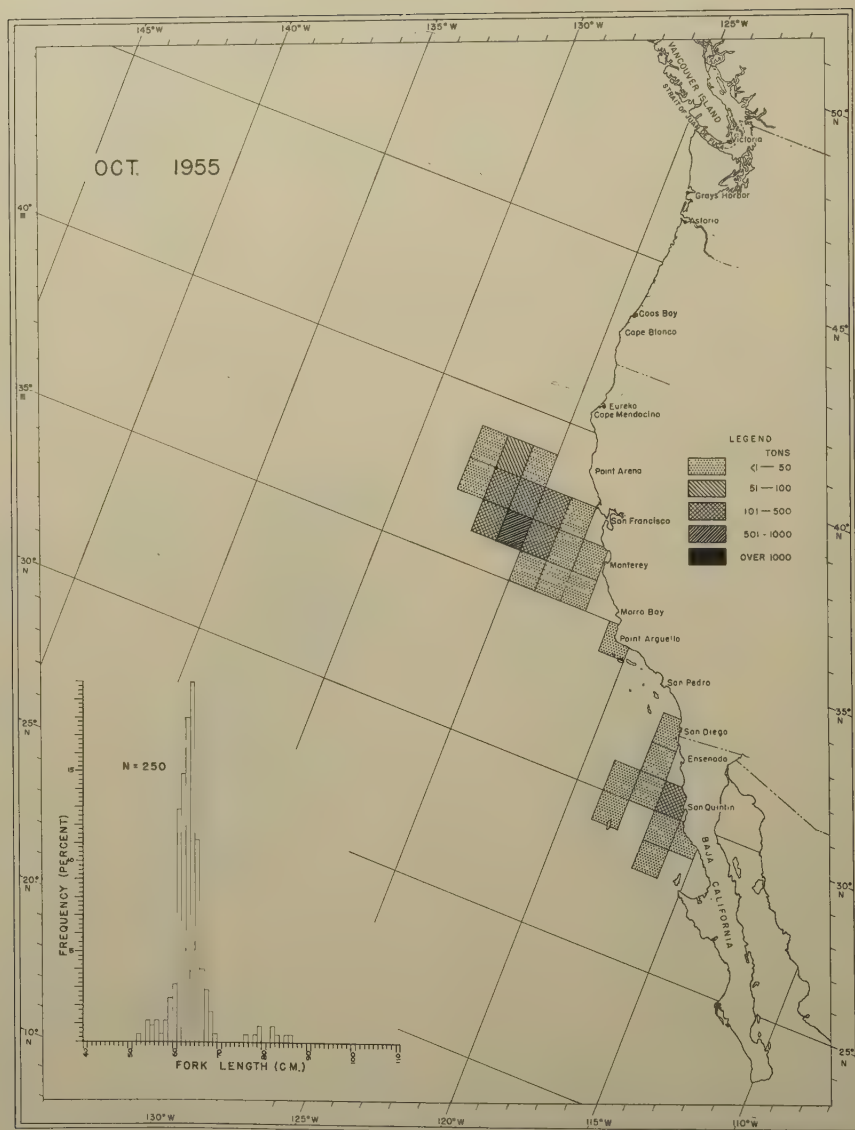
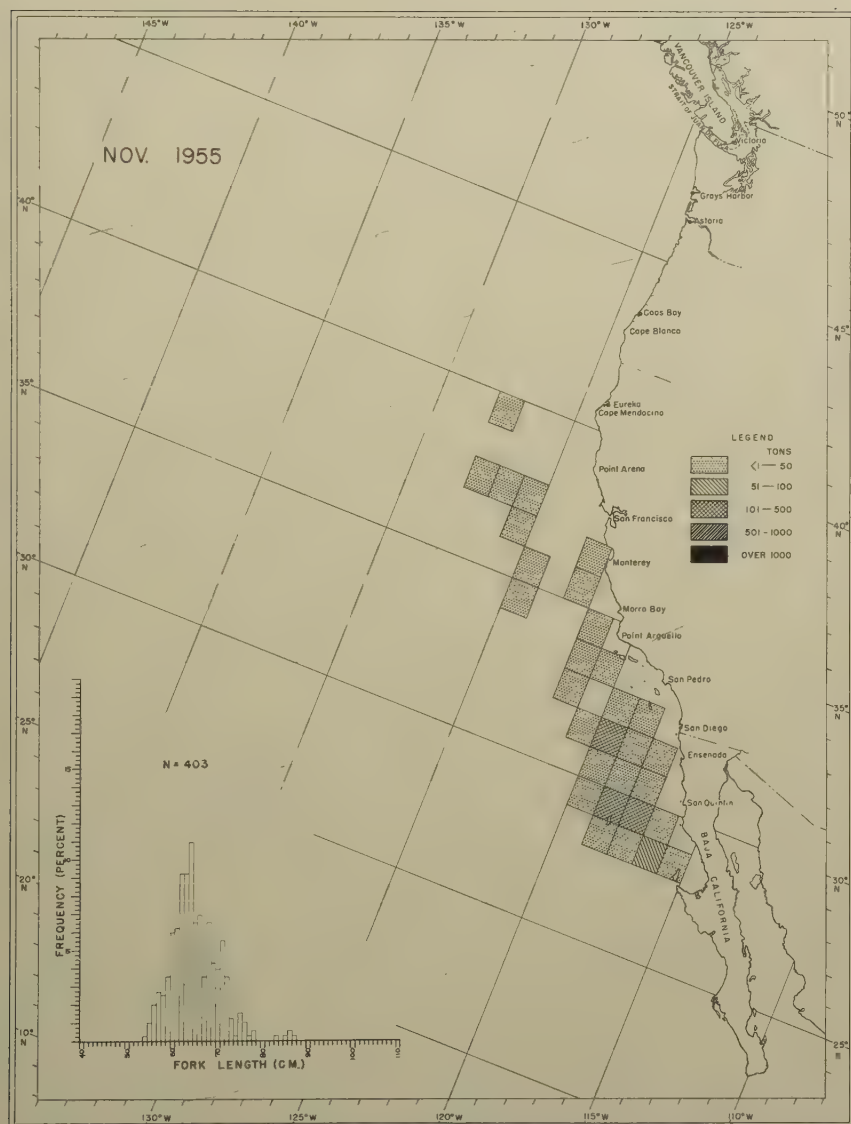


FIGURE 48. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.



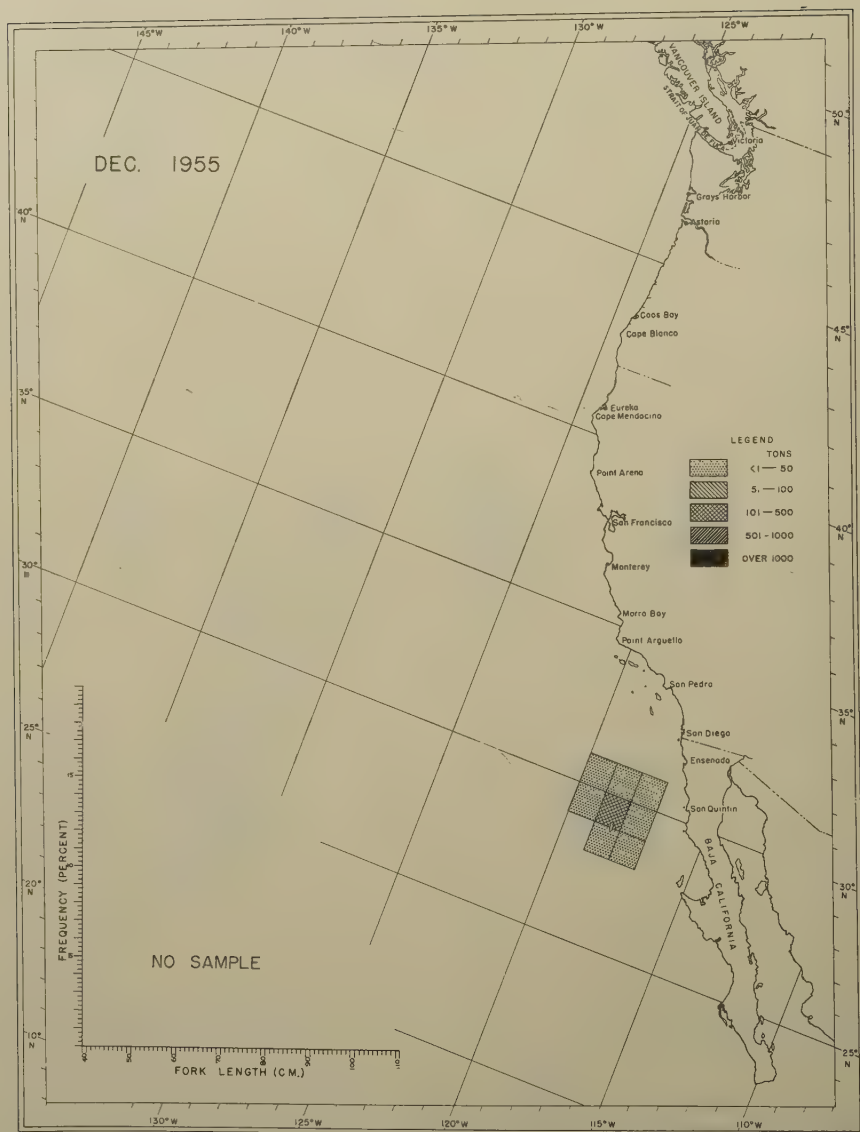


FIGURE 50. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

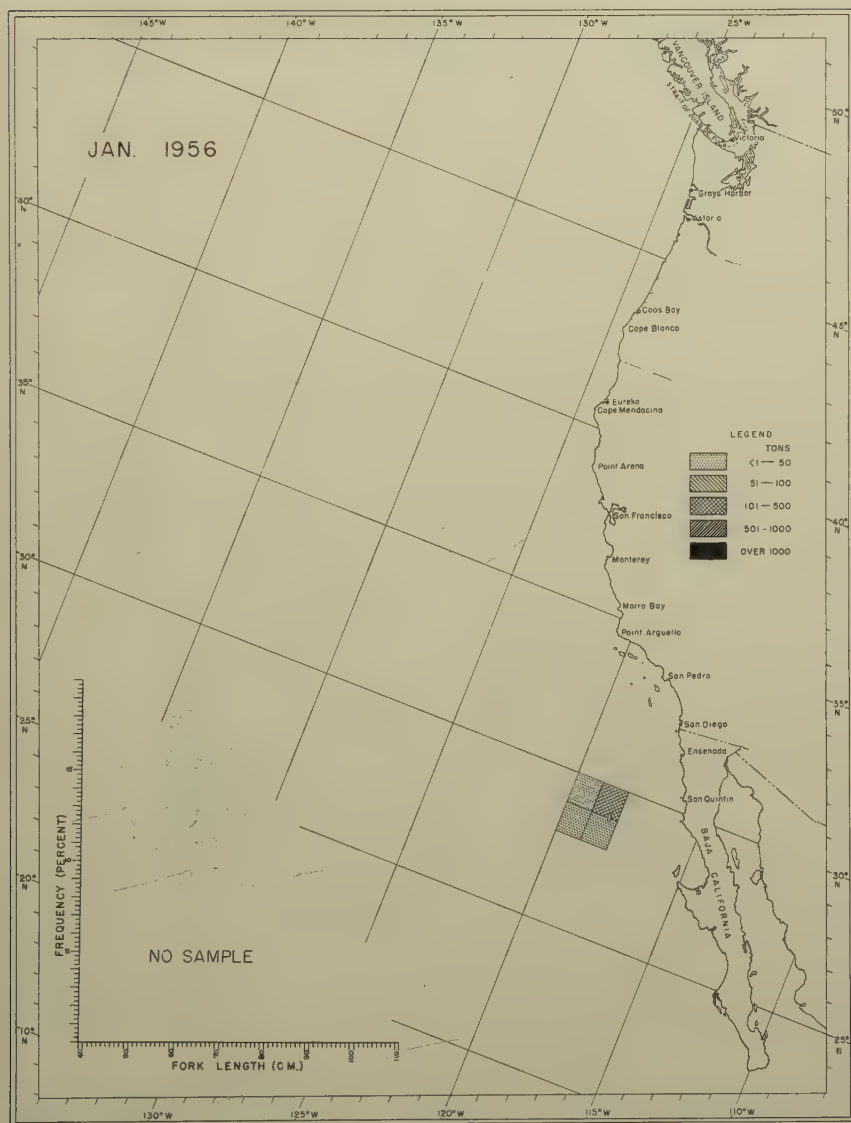


FIGURE 51. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

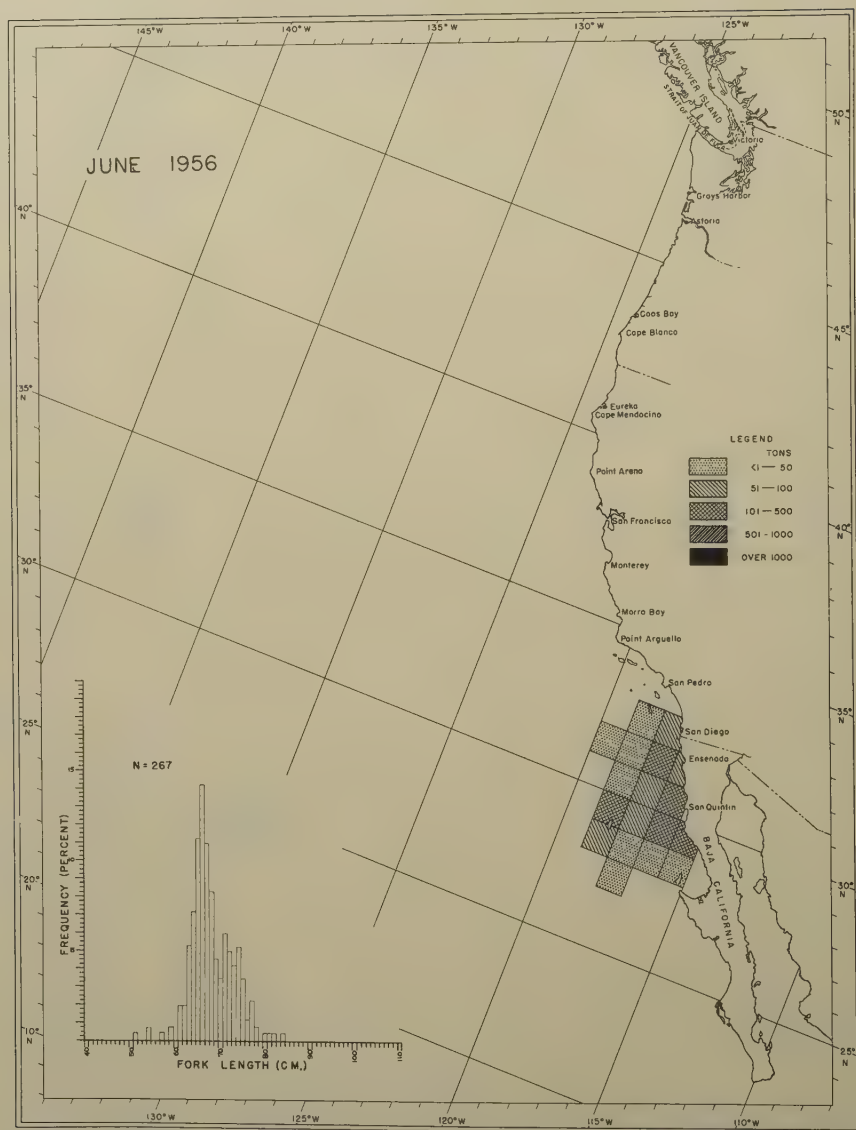
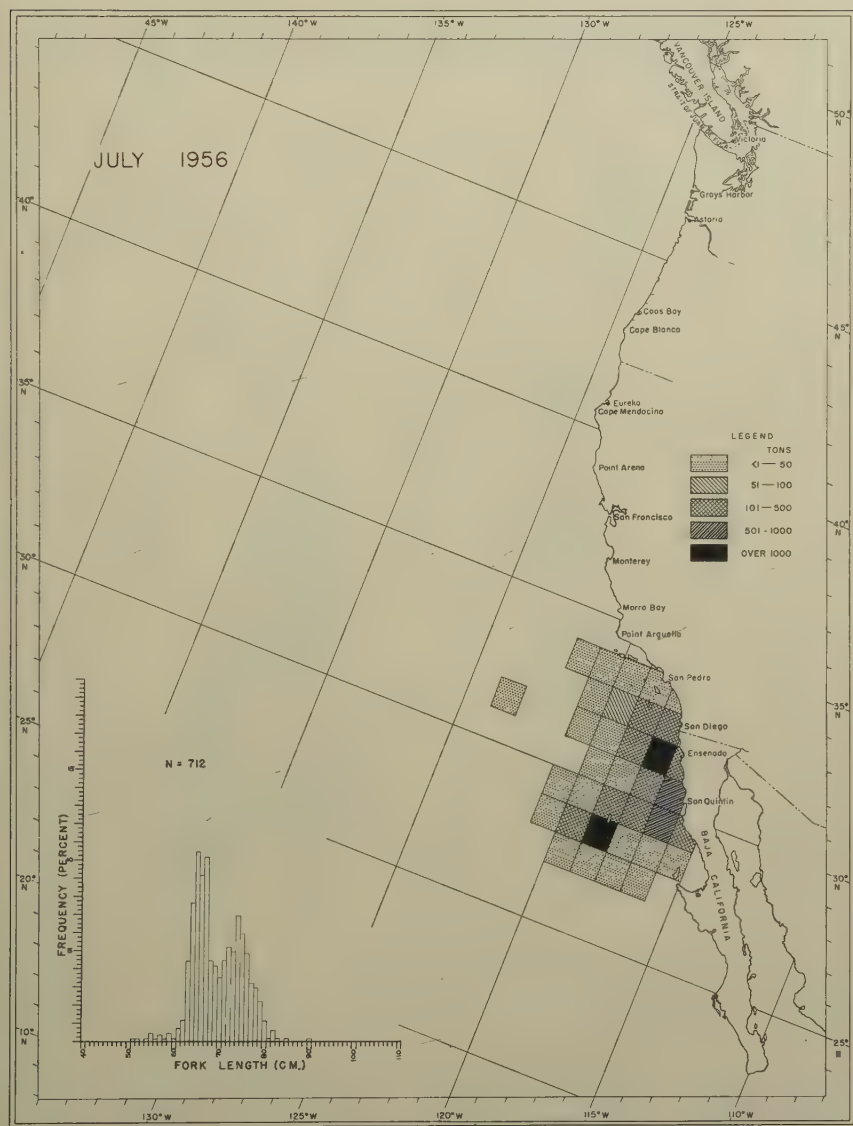


FIGURE 52. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.



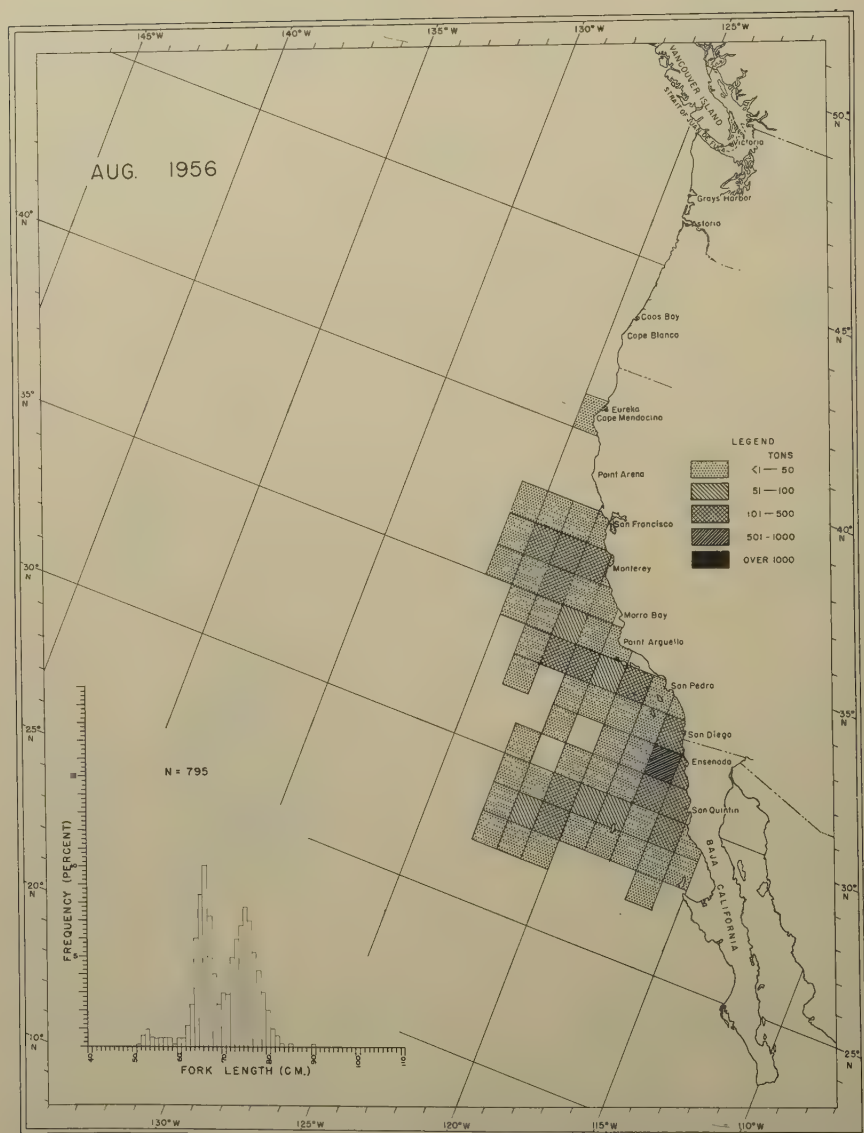
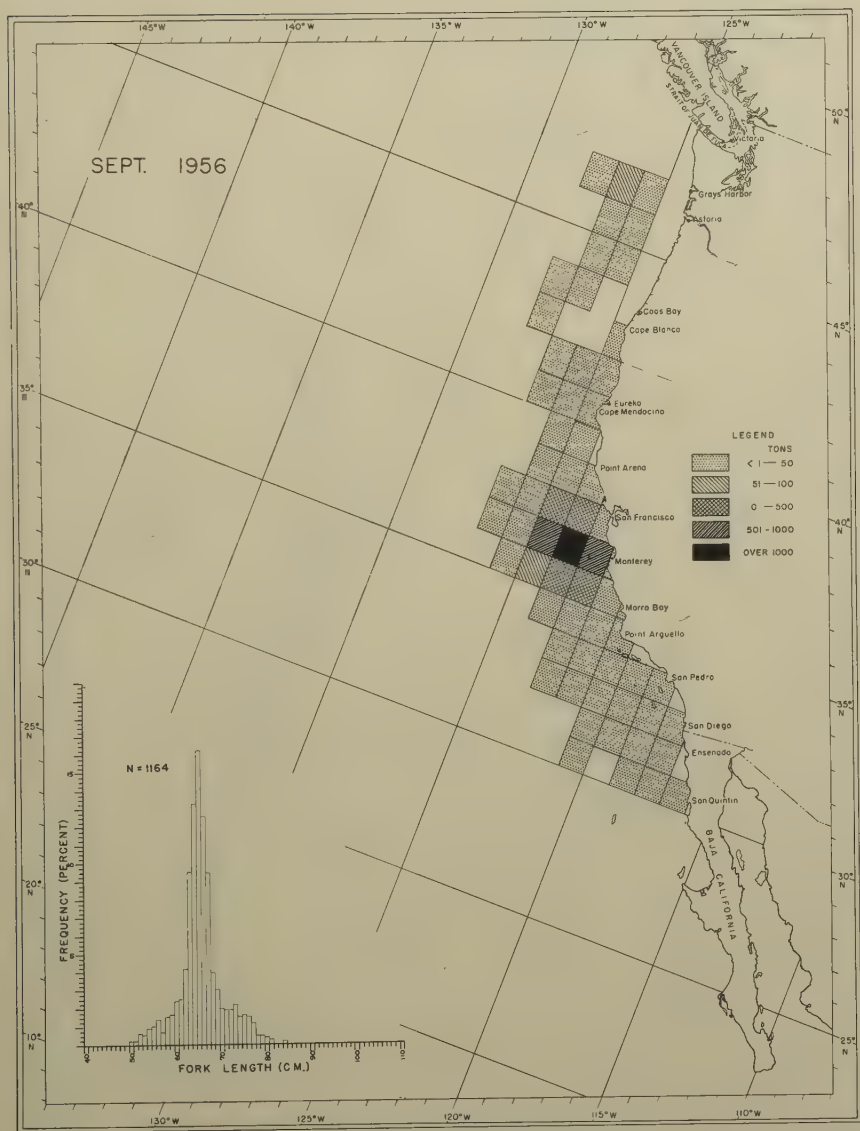


FIGURE 54. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.



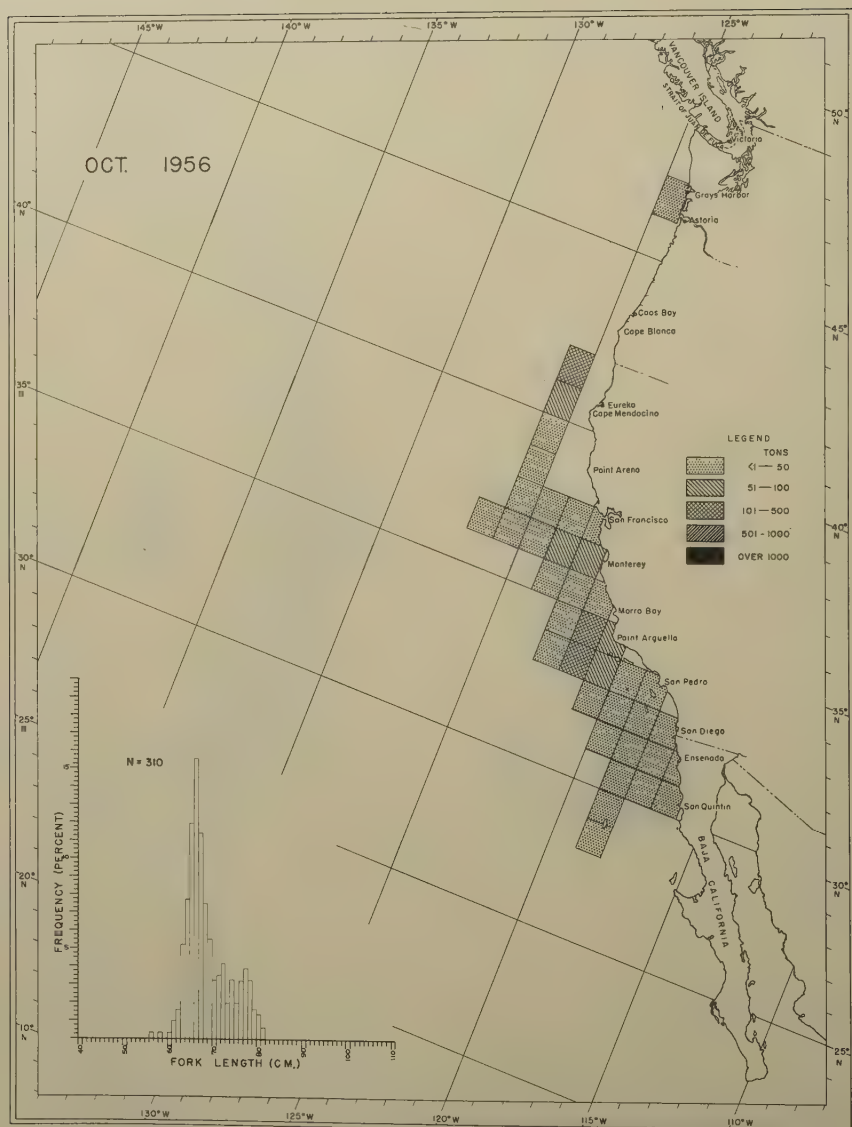


FIGURE 56. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

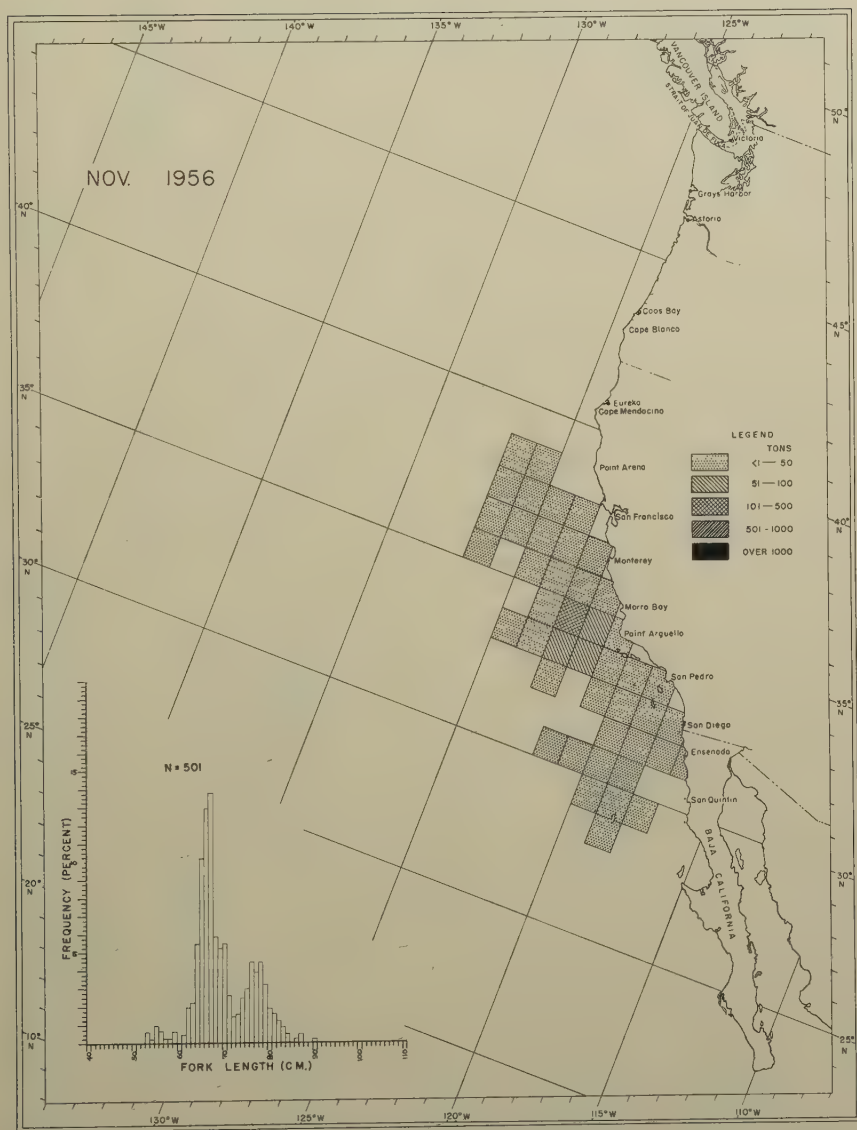


FIGURE 57. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

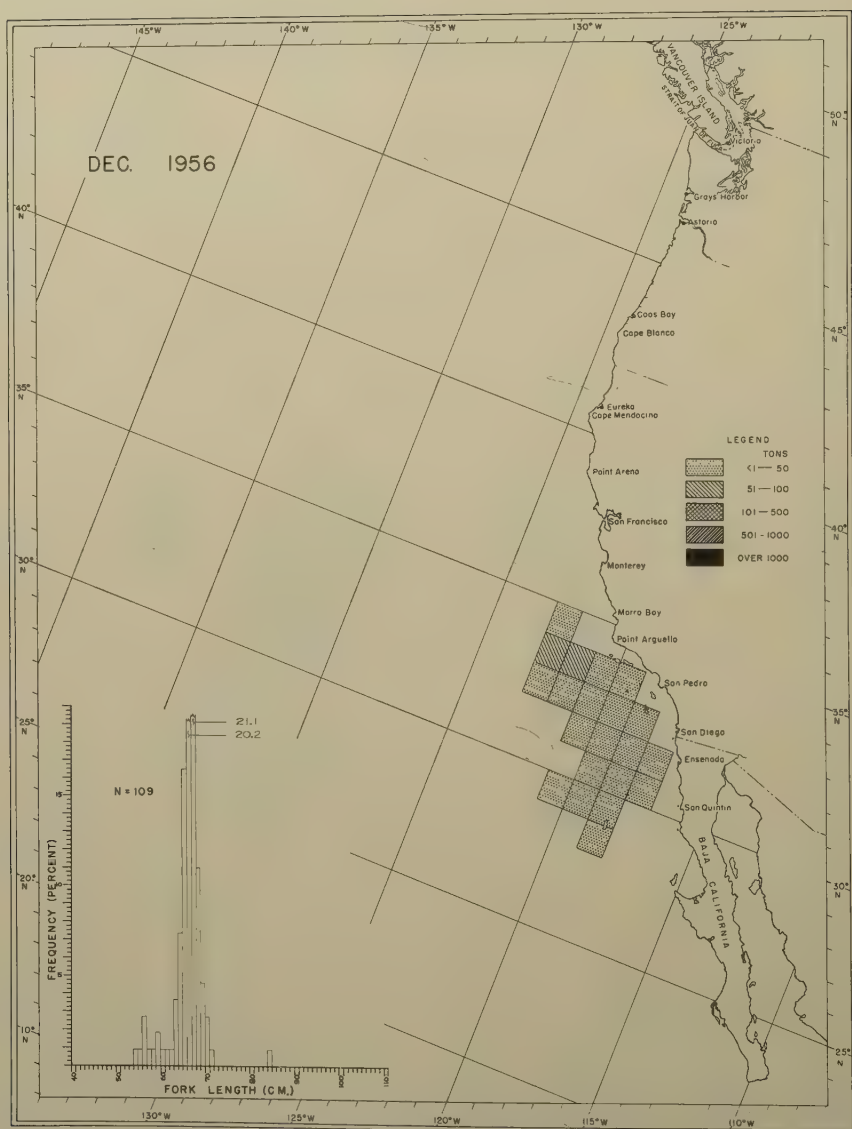


FIGURE 58. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

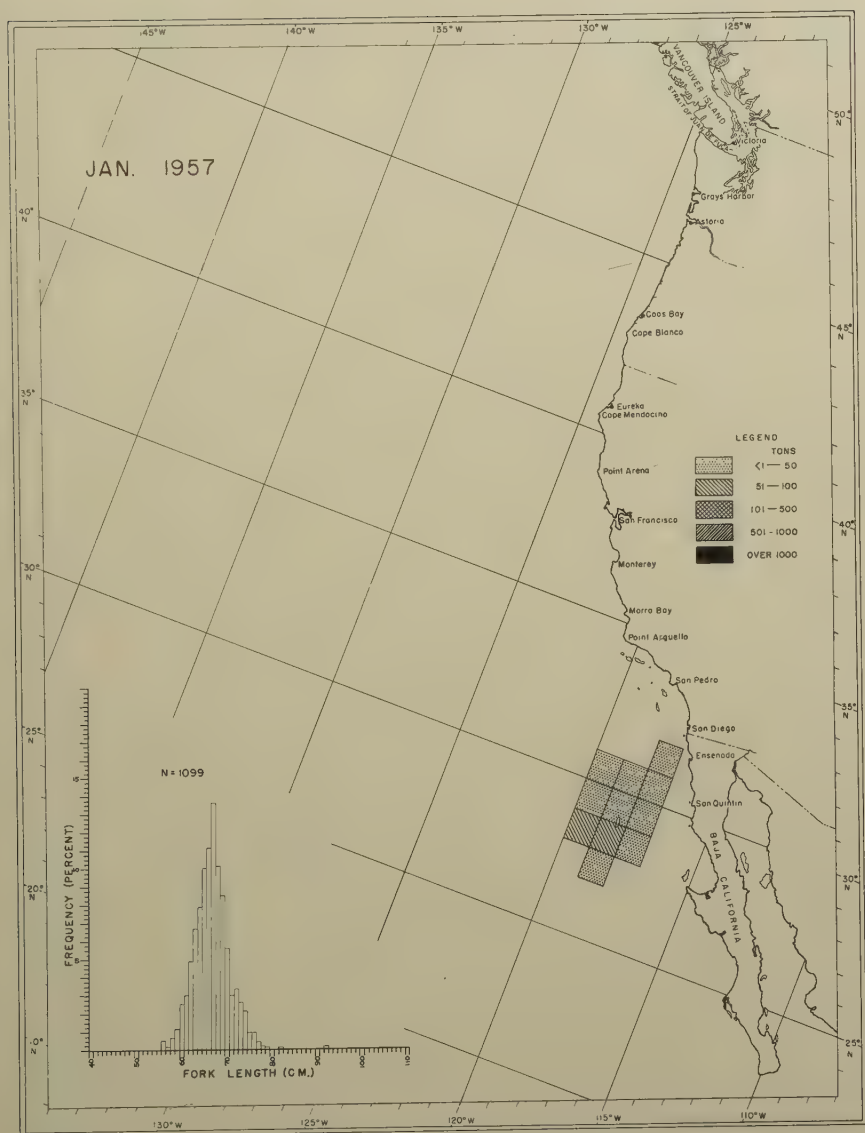


FIGURE 59. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

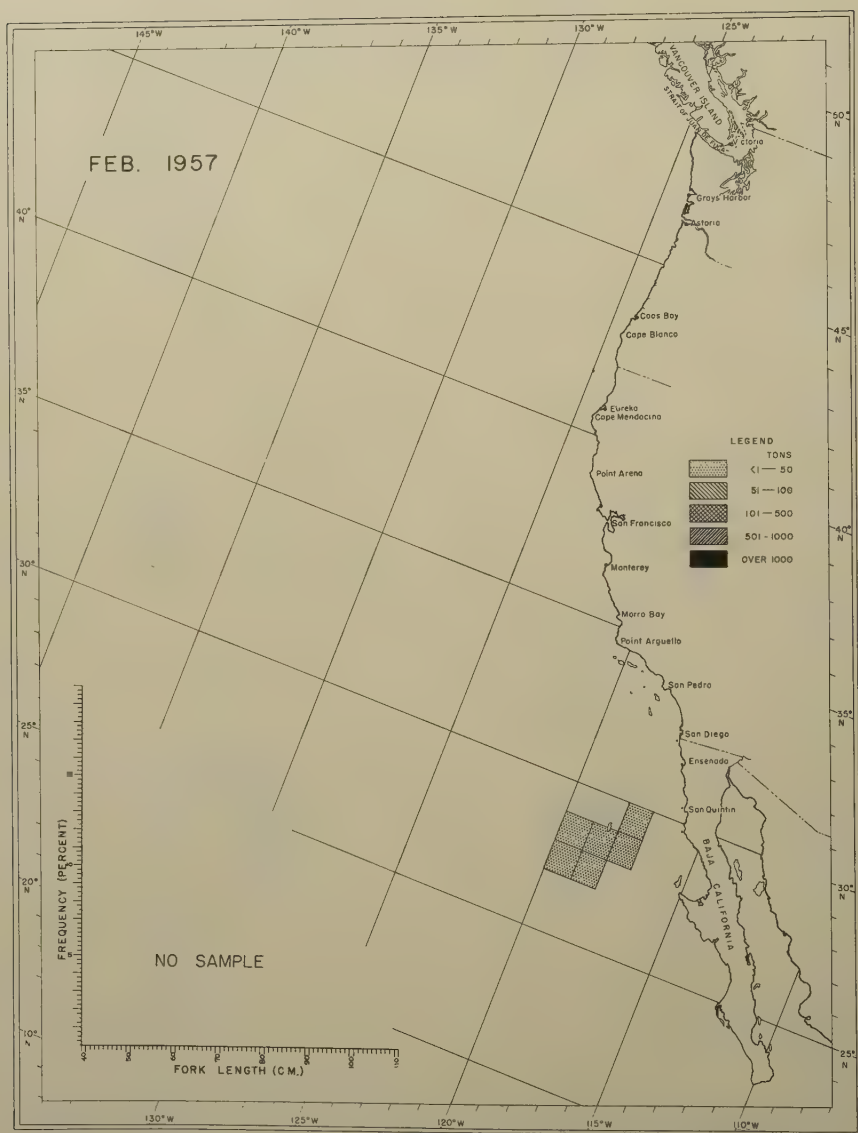


FIGURE 60. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

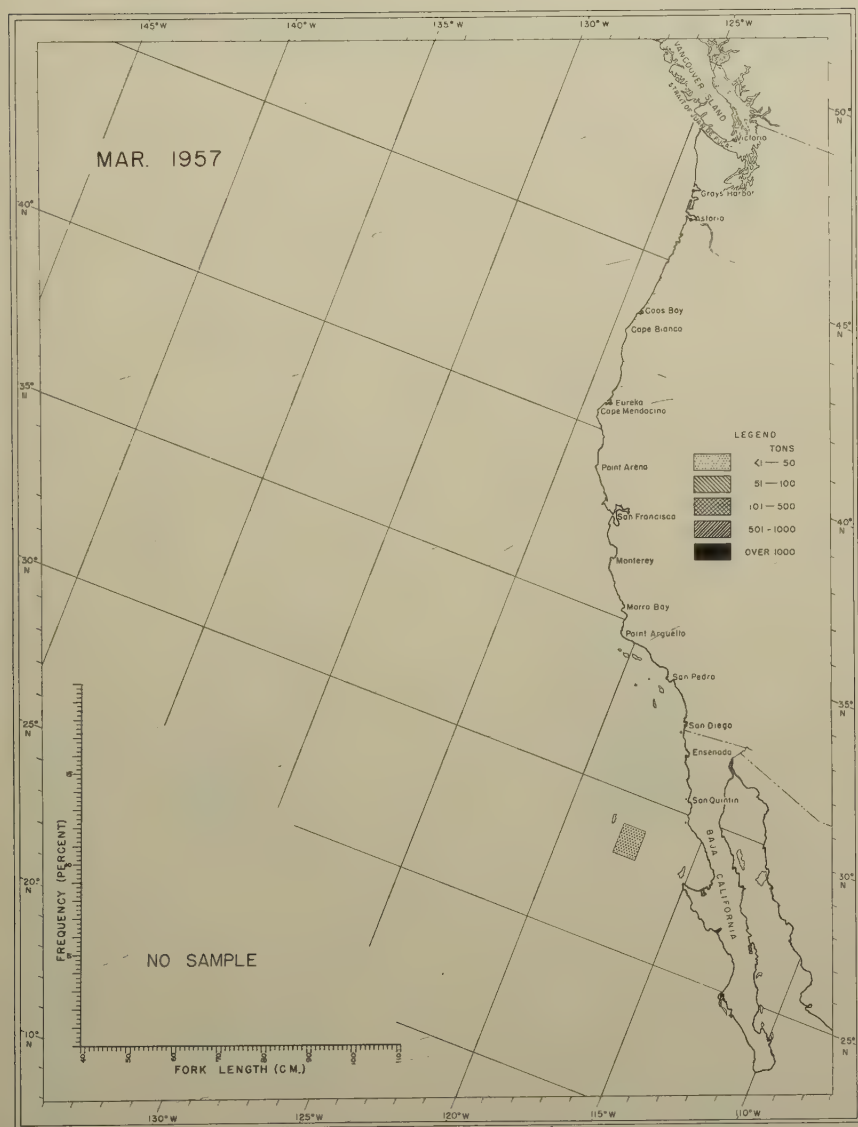


FIGURE 61. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

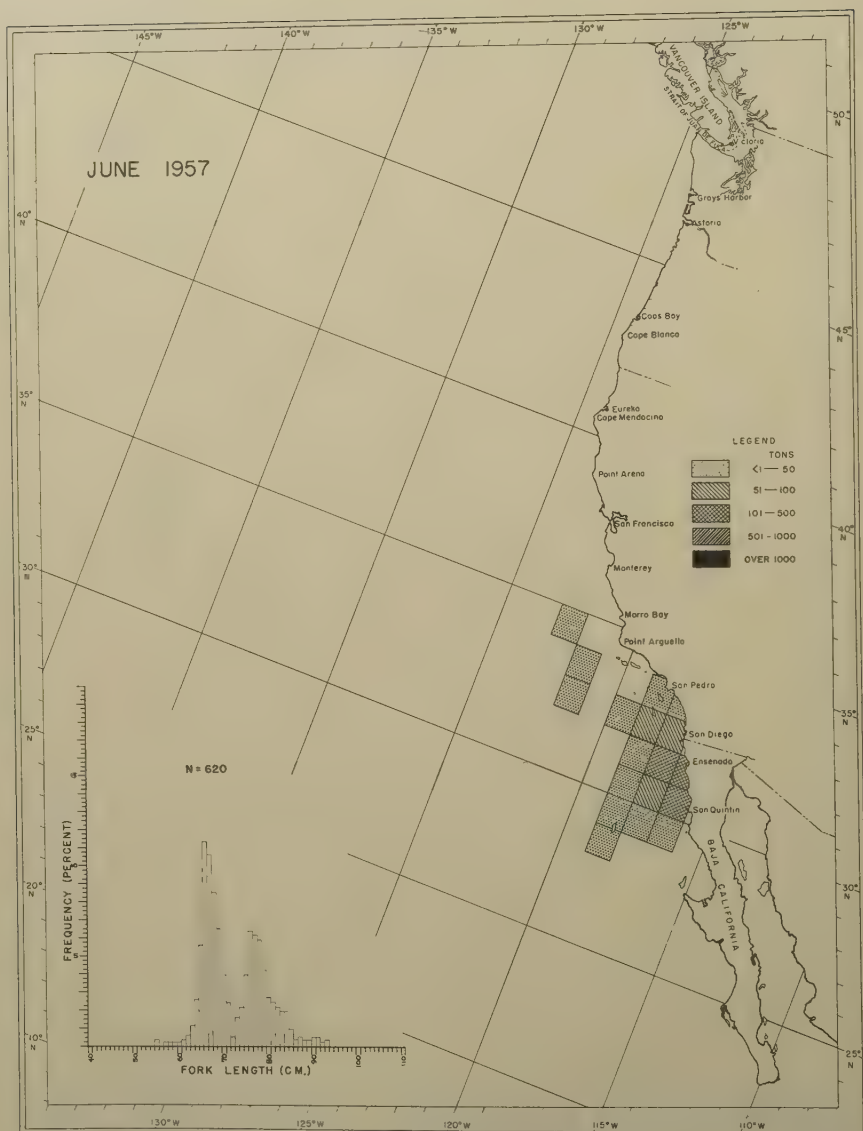


FIGURE 62. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

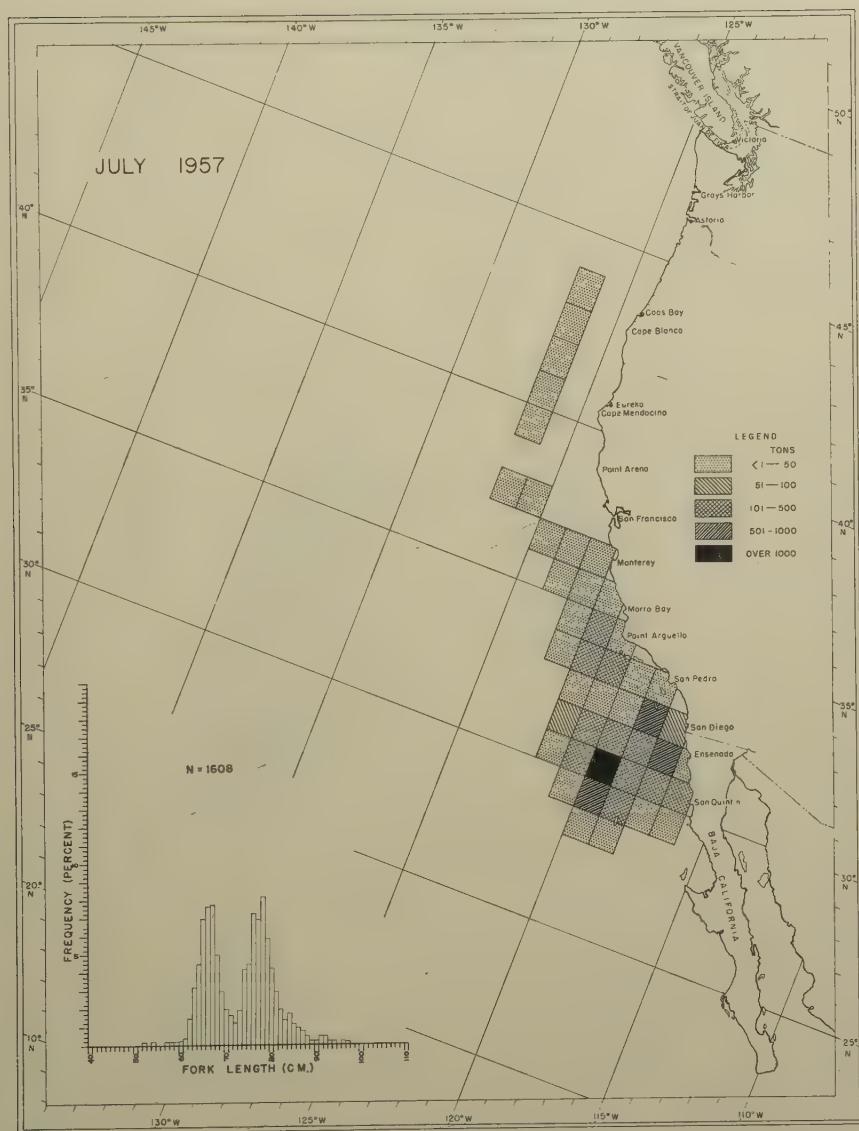


FIGURE 63. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

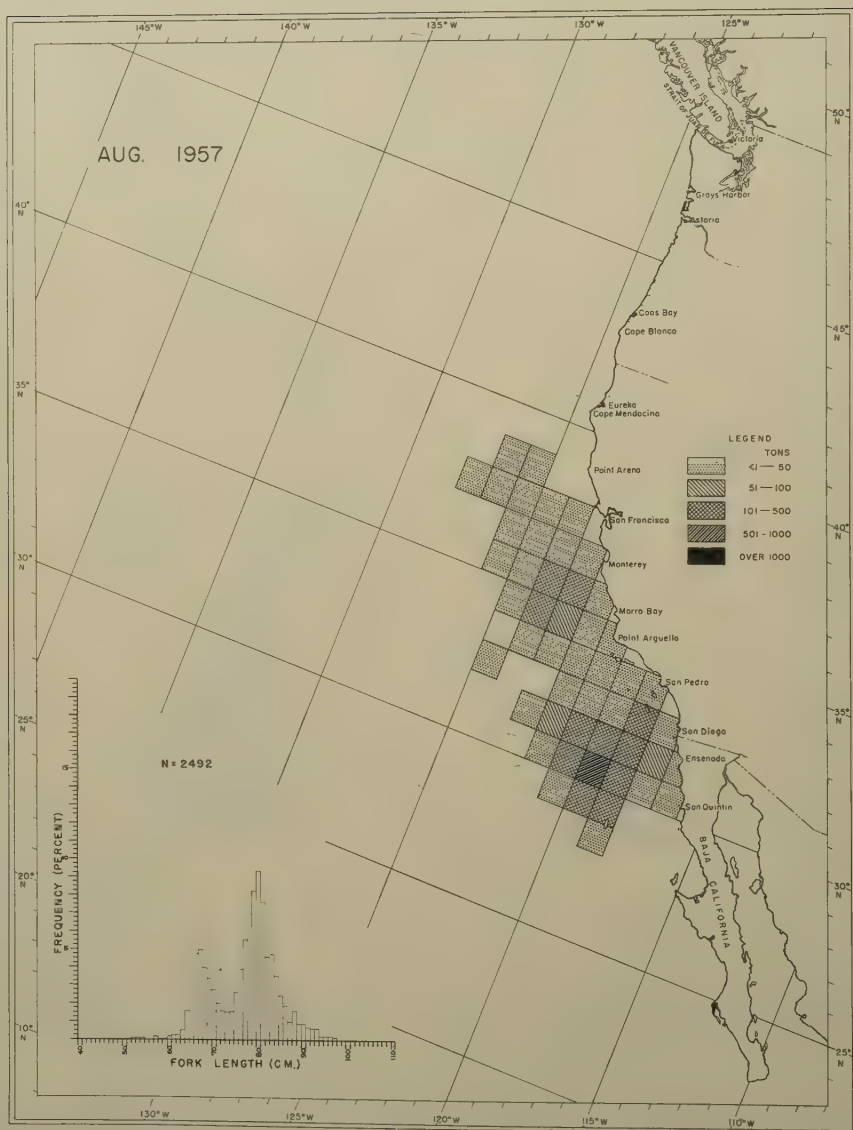


FIGURE 64. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

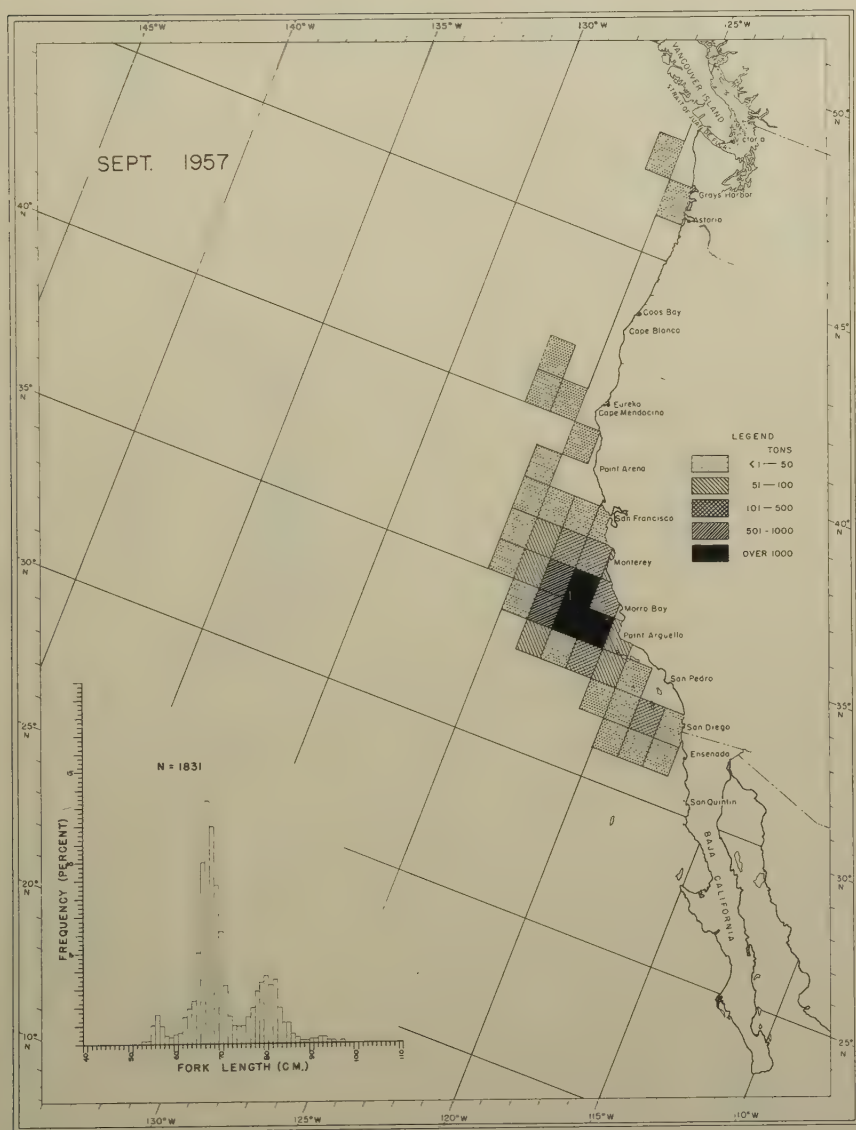


FIGURE 65. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

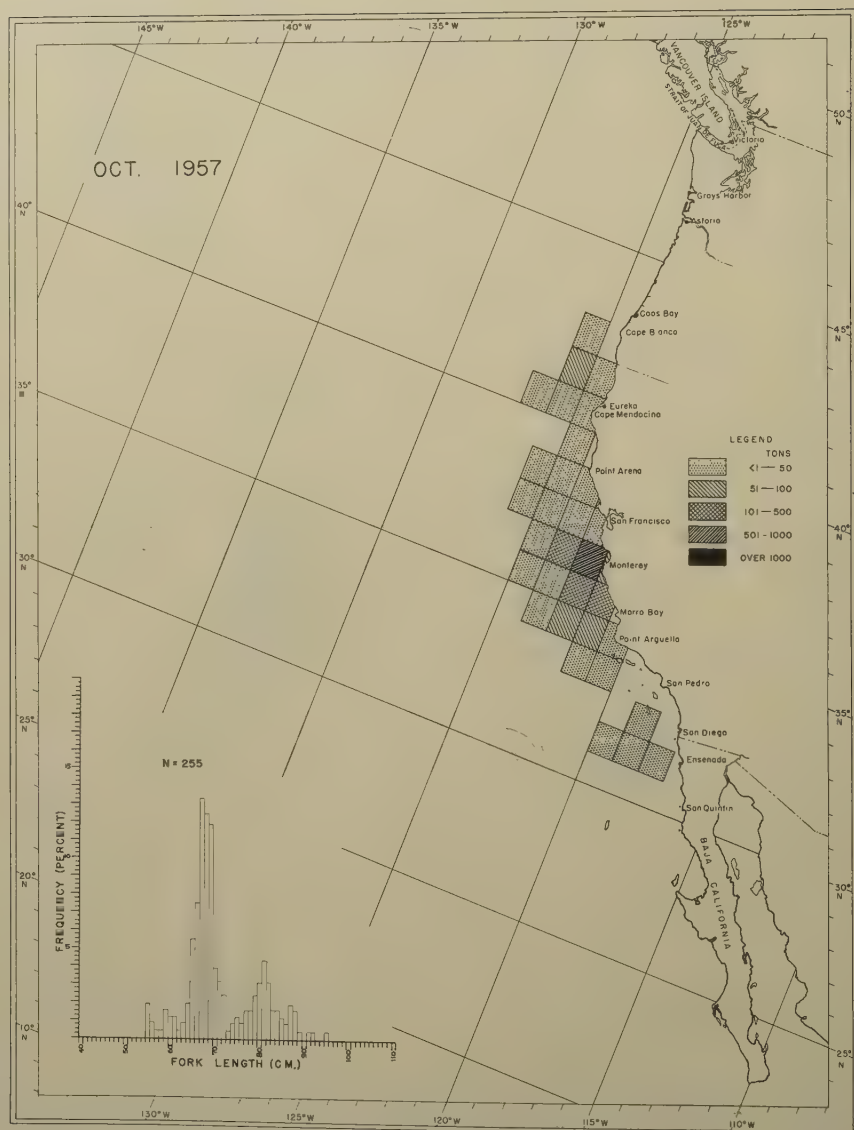


FIGURE 66. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

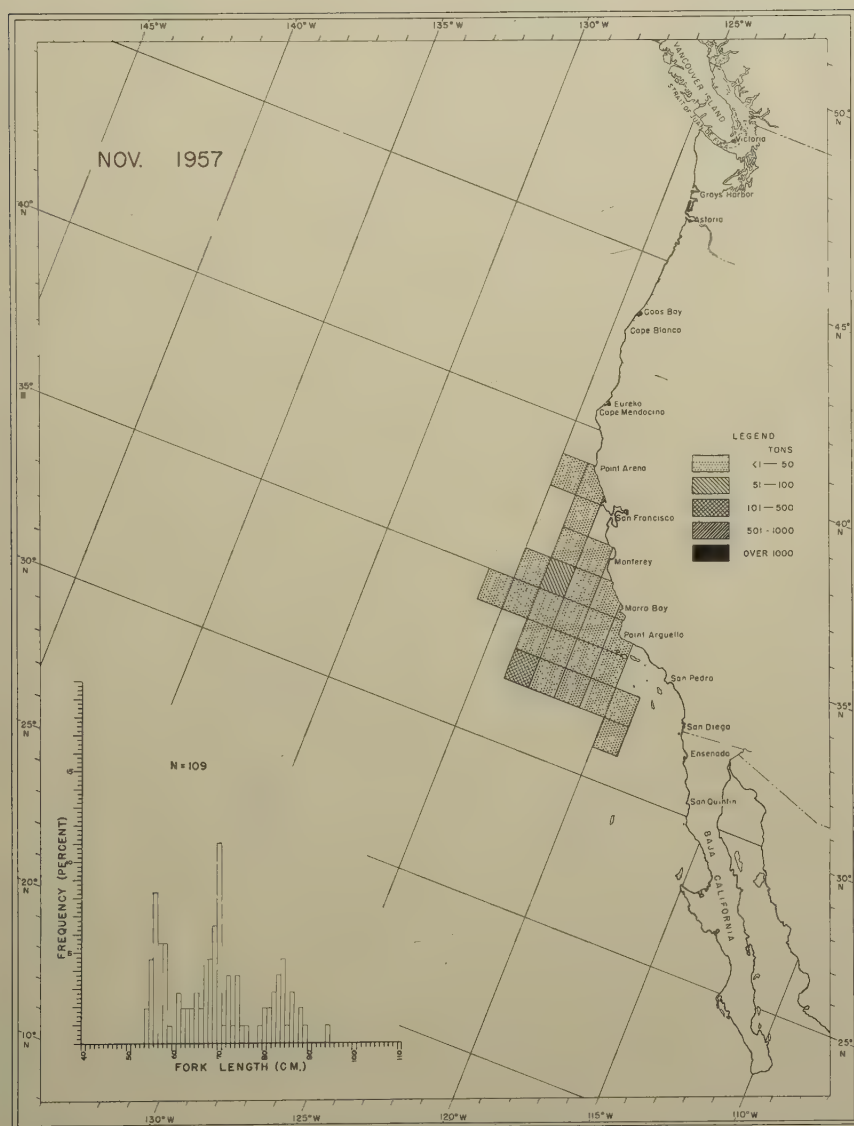


FIGURE 67. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

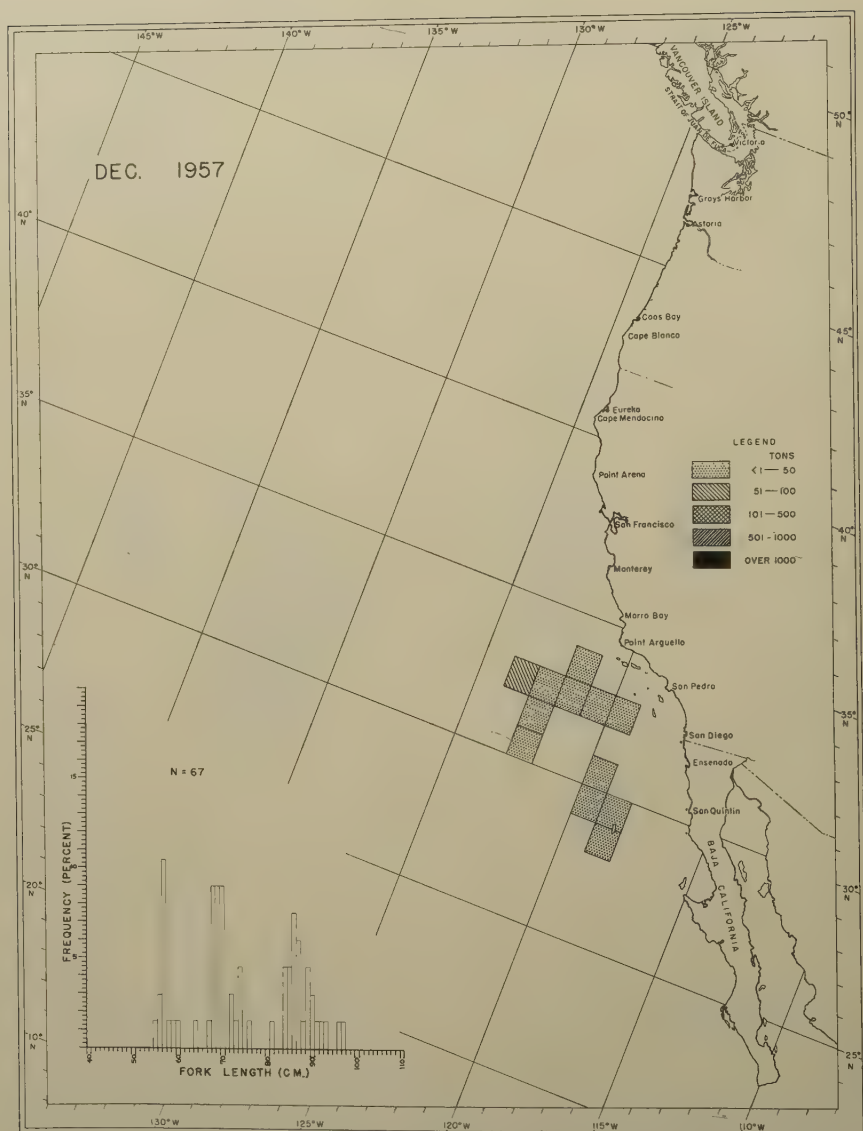


FIGURE 68. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

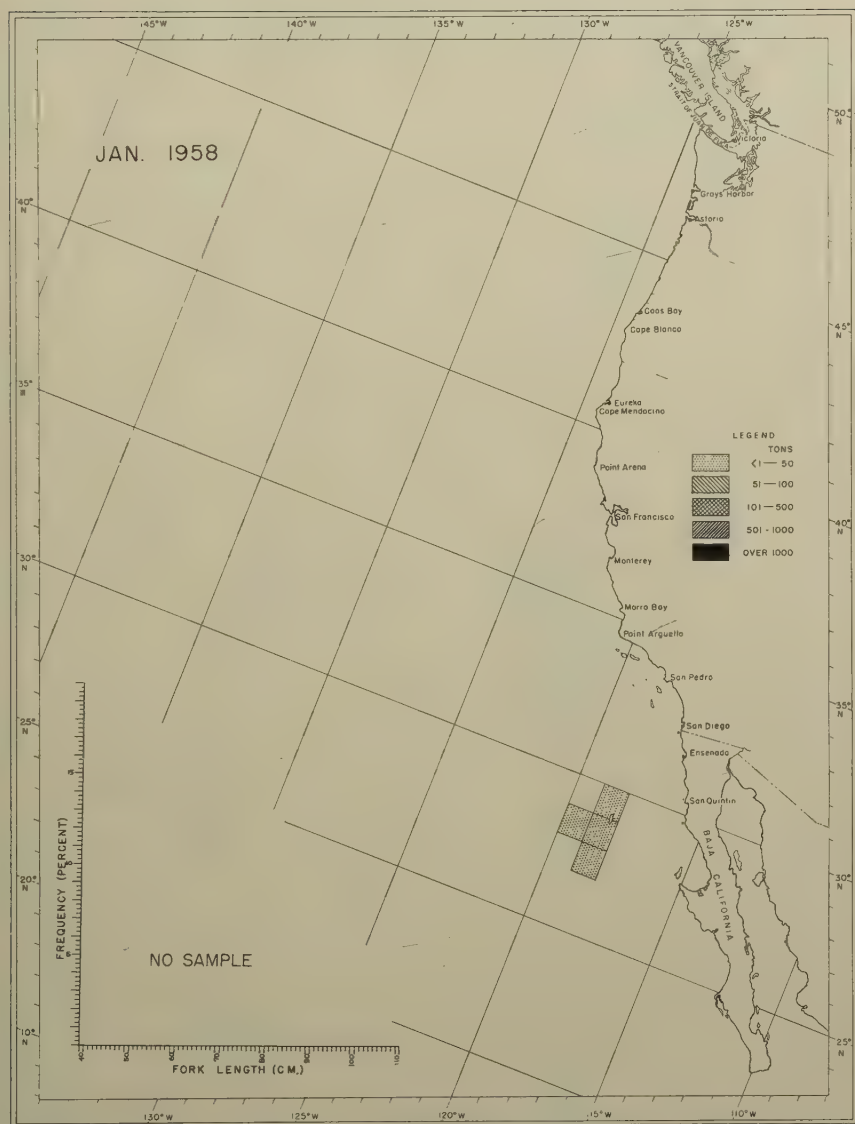


FIGURE 69. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

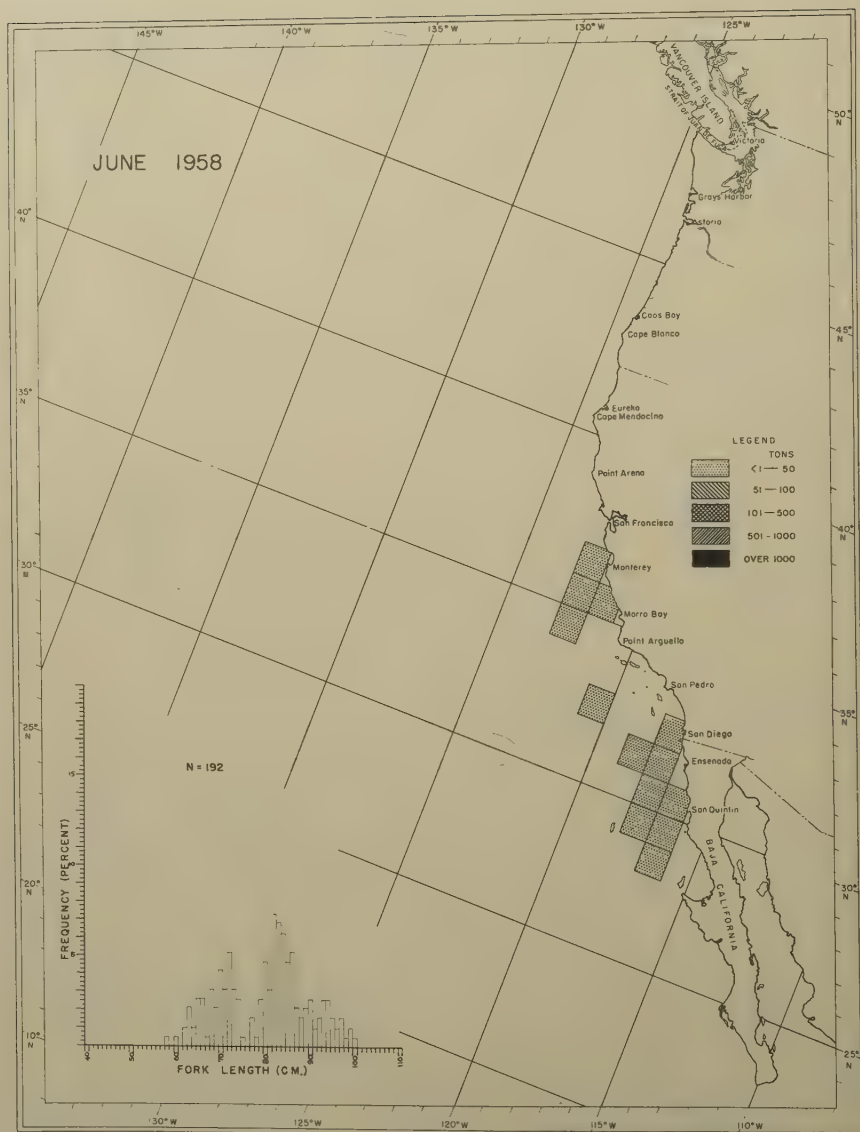


FIGURE 70. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

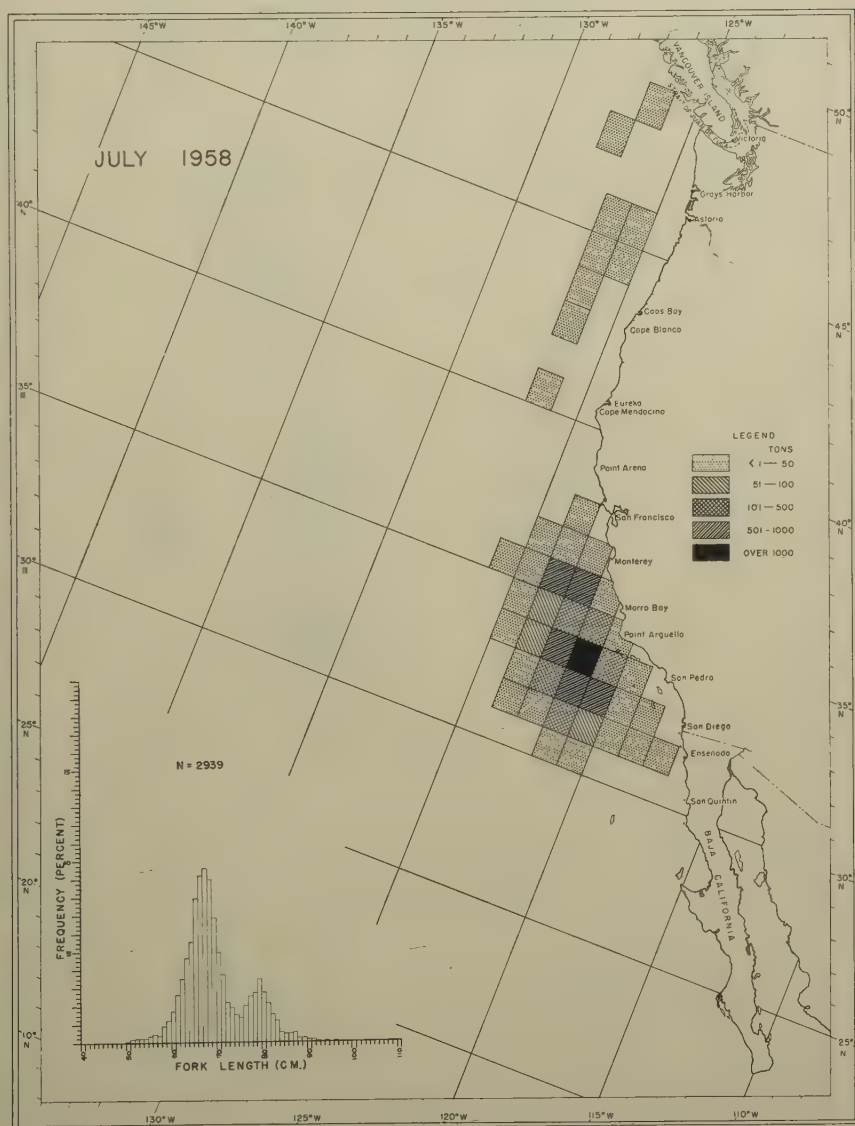


FIGURE 71. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

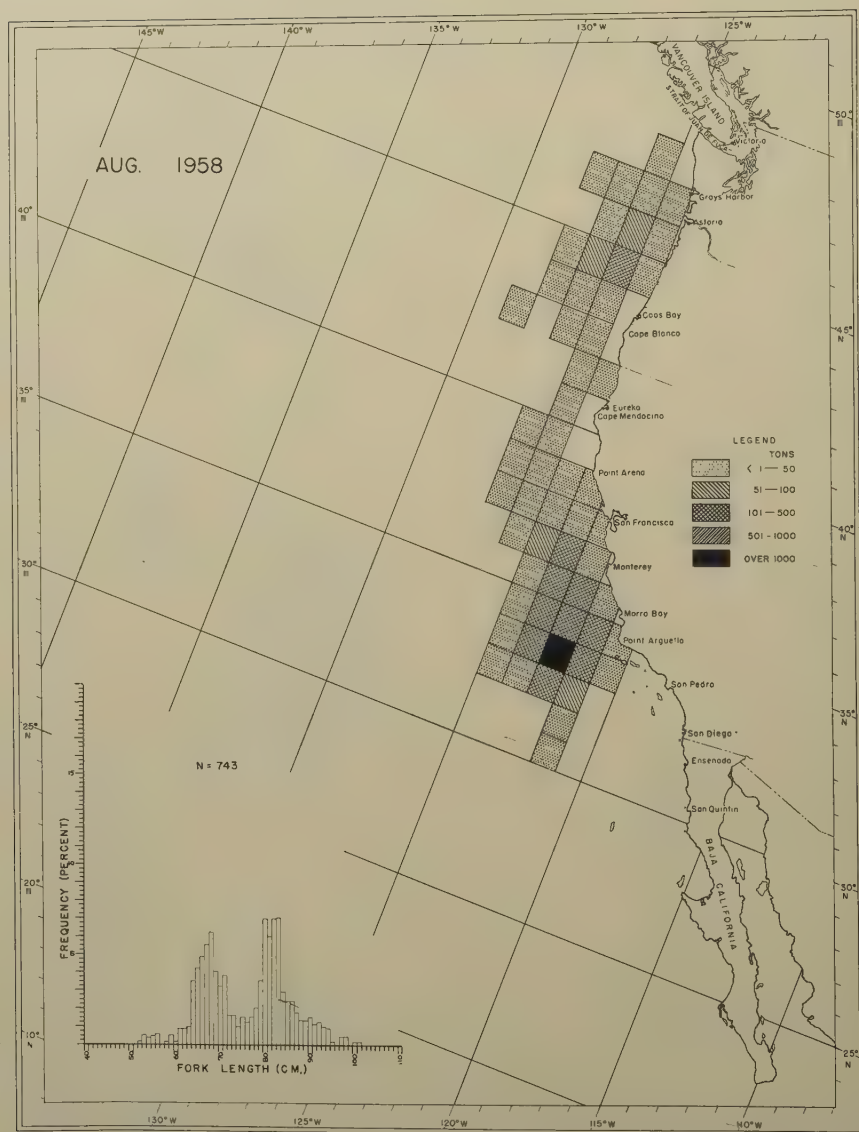


FIGURE 72. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

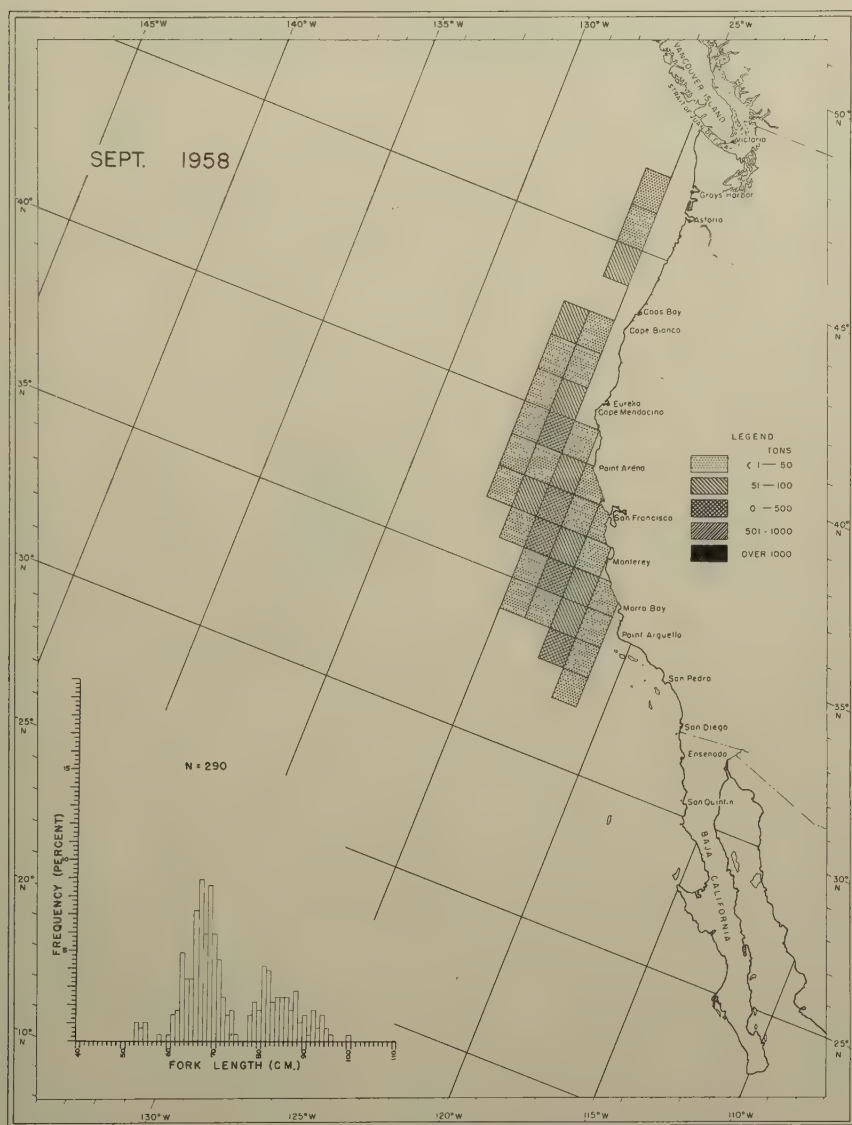


FIGURE 73. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

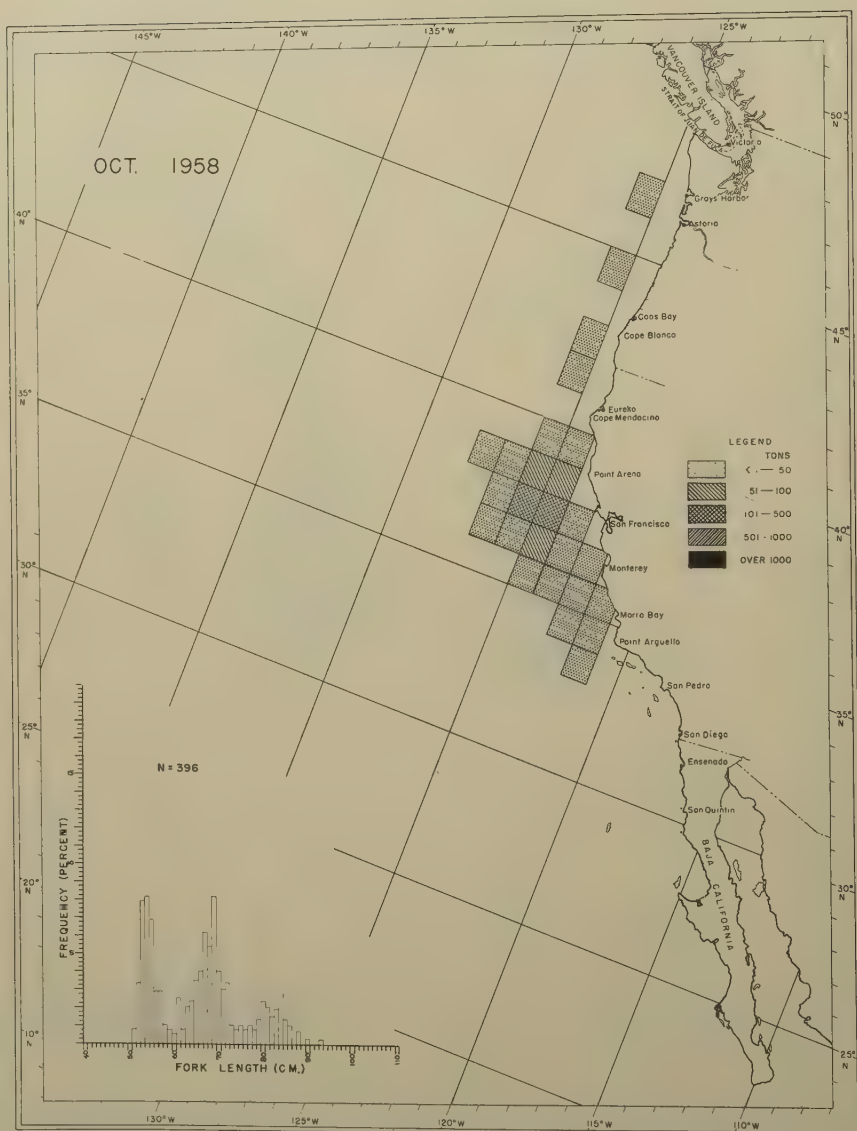


FIGURE 74. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

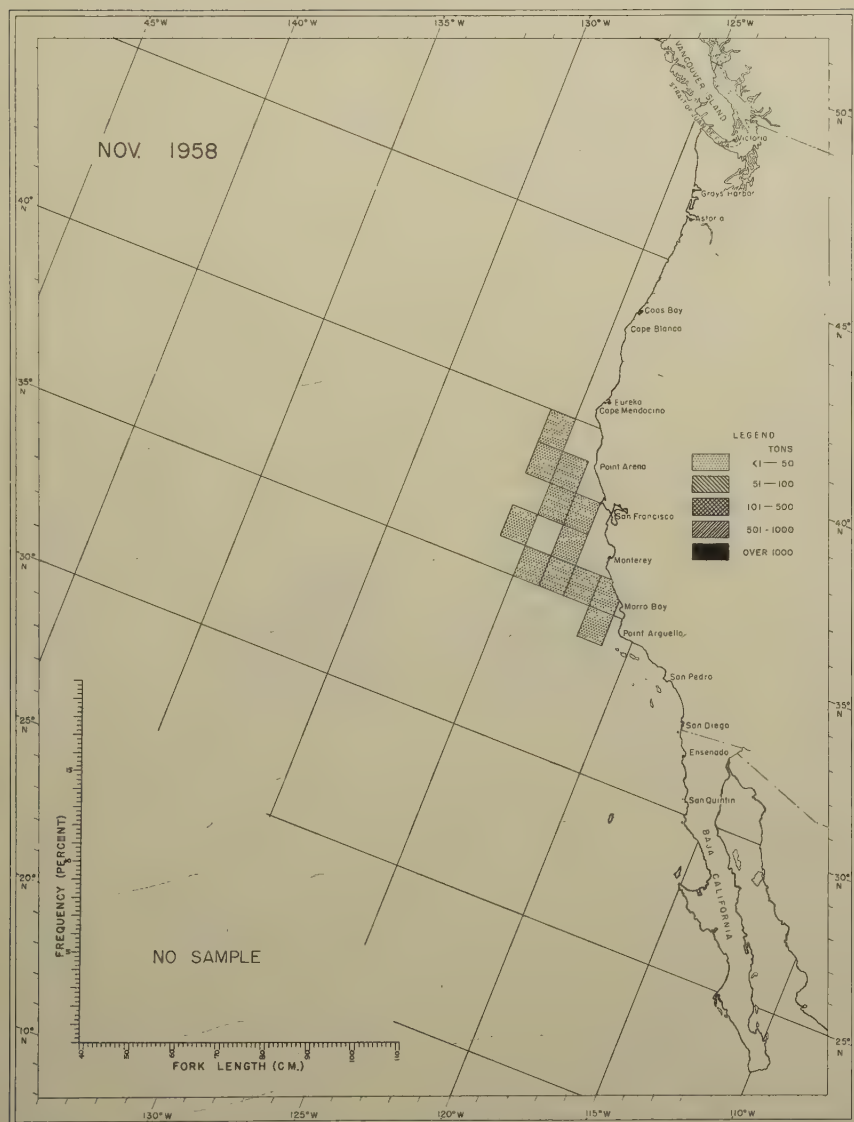


FIGURE 75. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

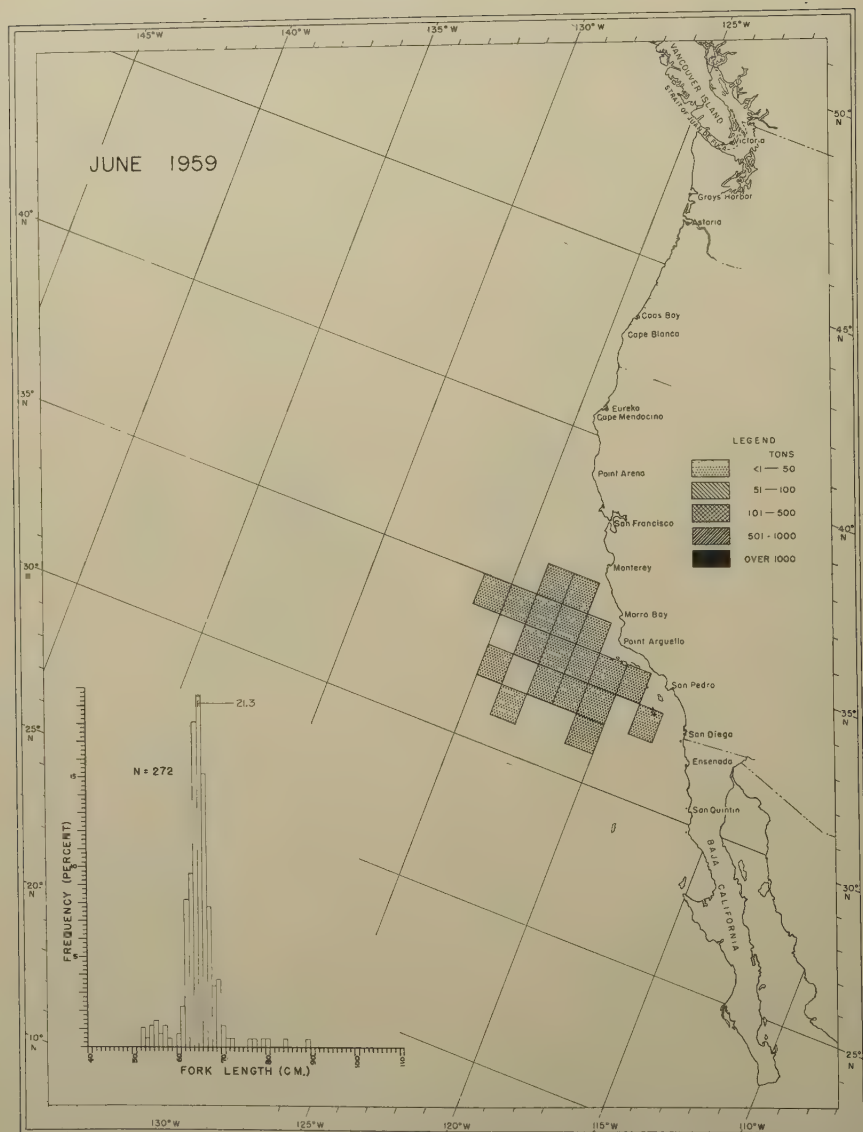


FIGURE 76. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

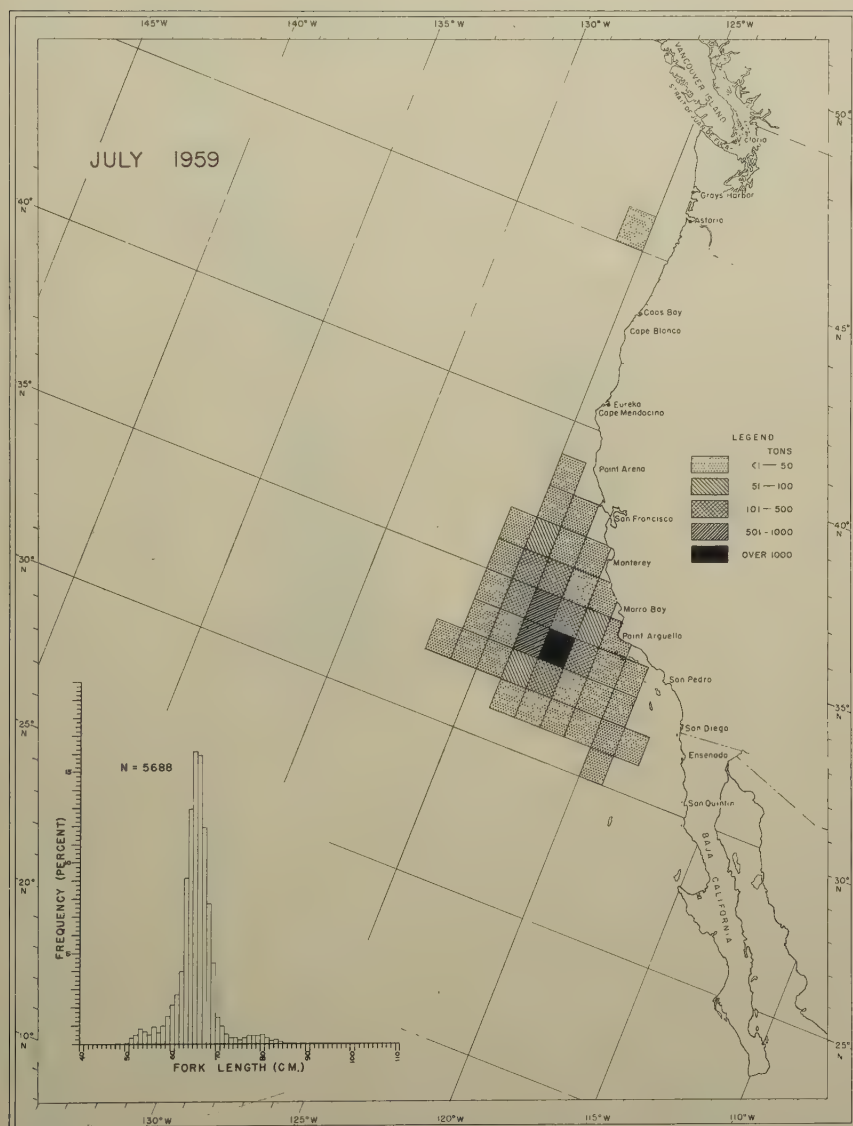


FIGURE 77. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

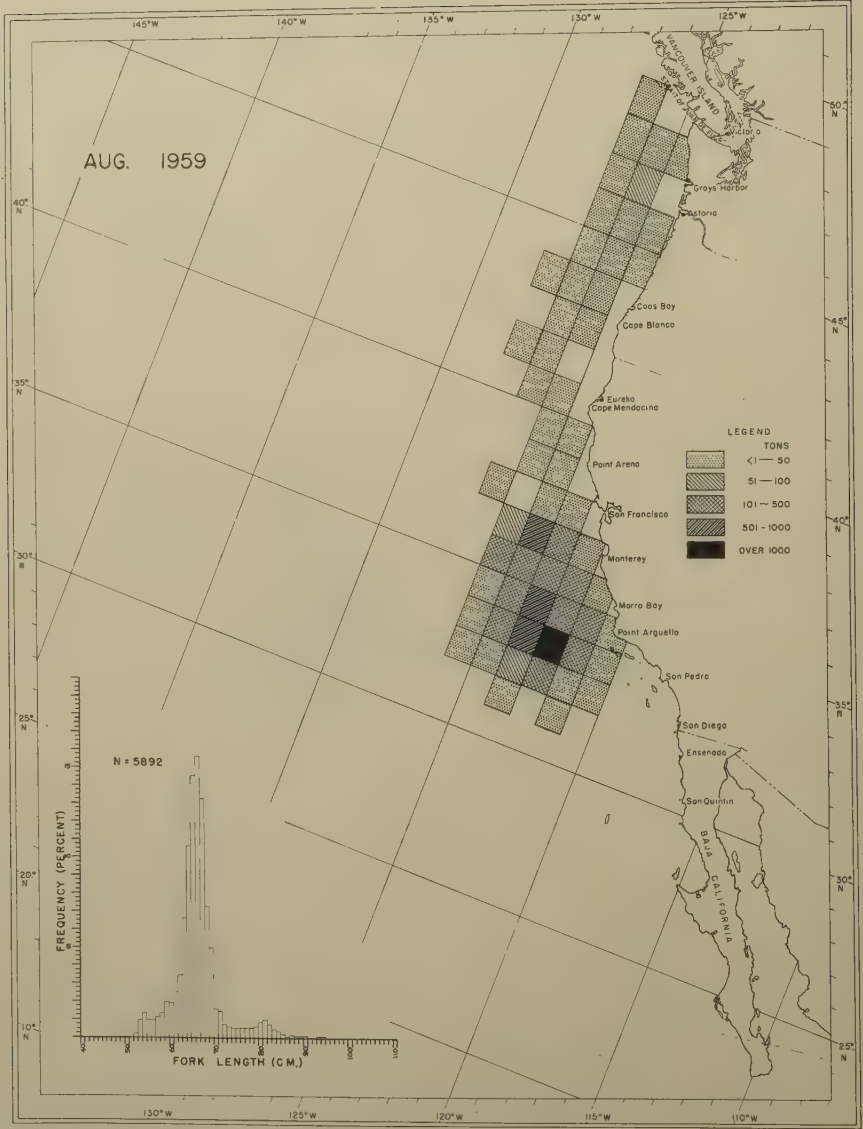


FIGURE 78. Albatross catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

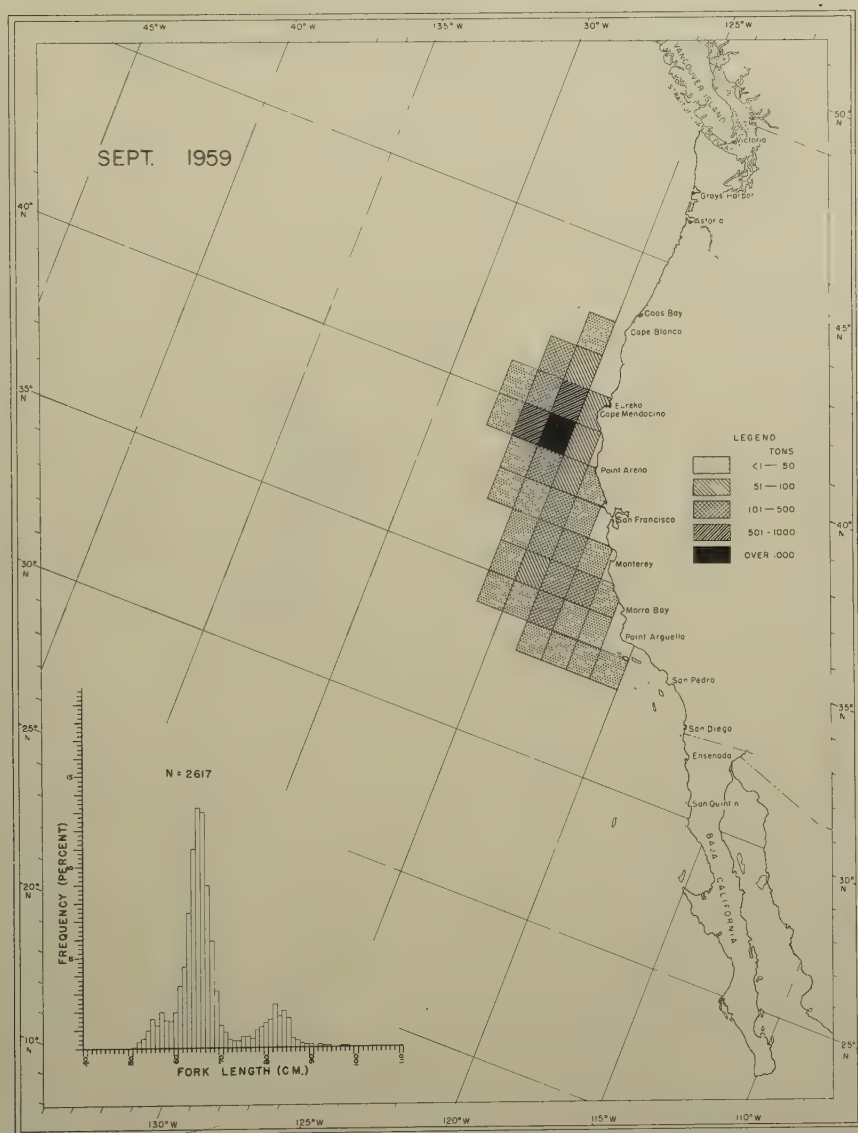


FIGURE 79. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

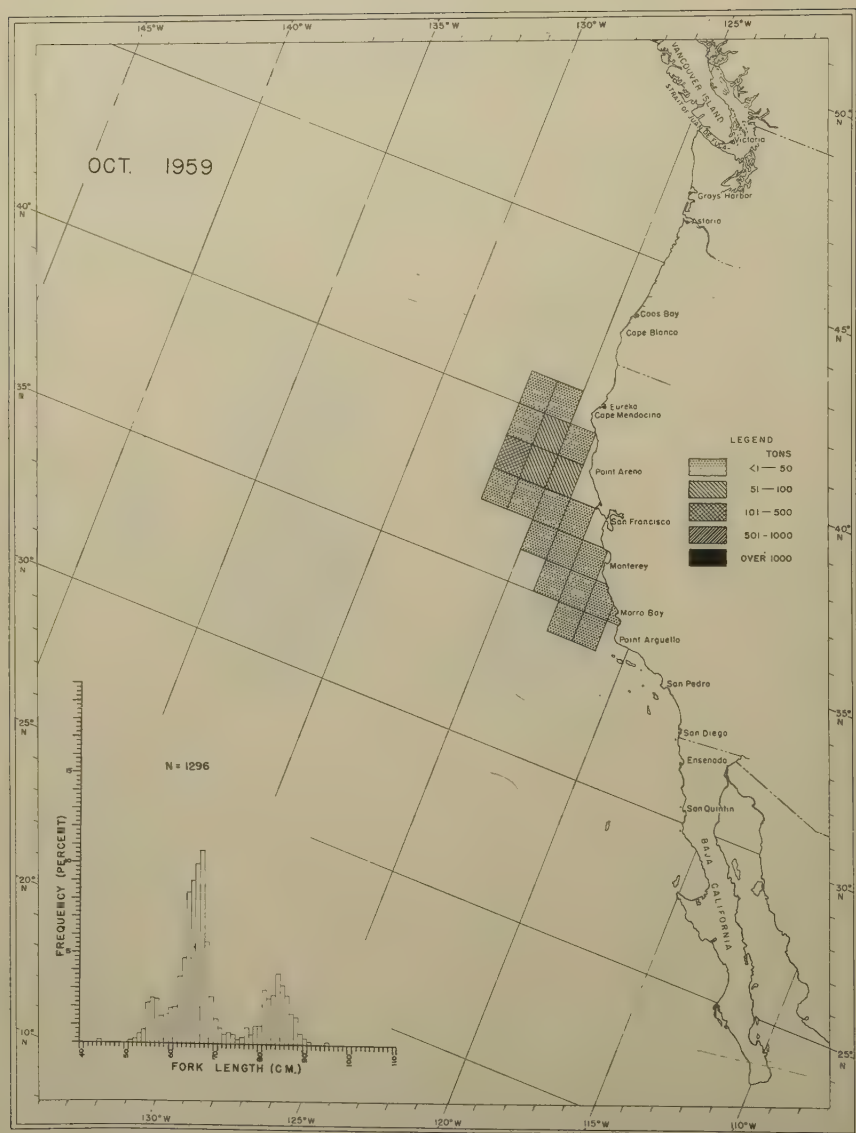


FIGURE 80. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

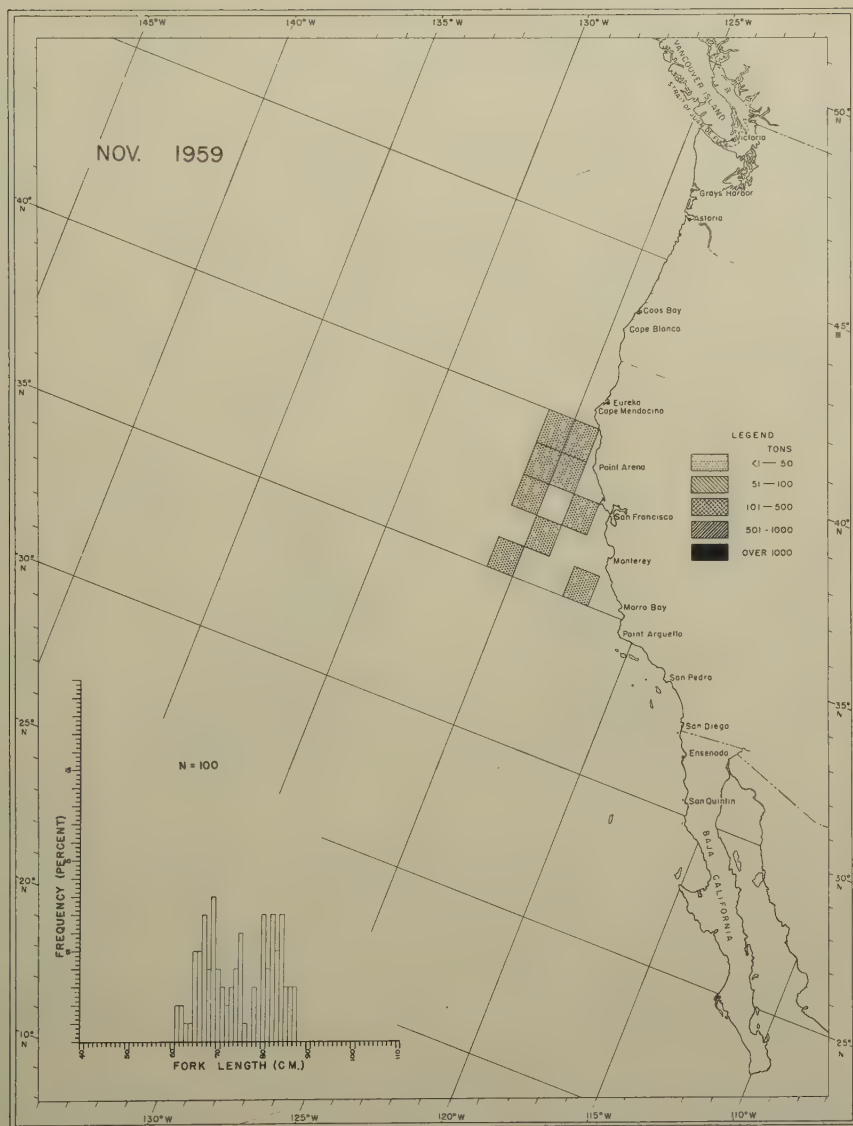


FIGURE 81. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

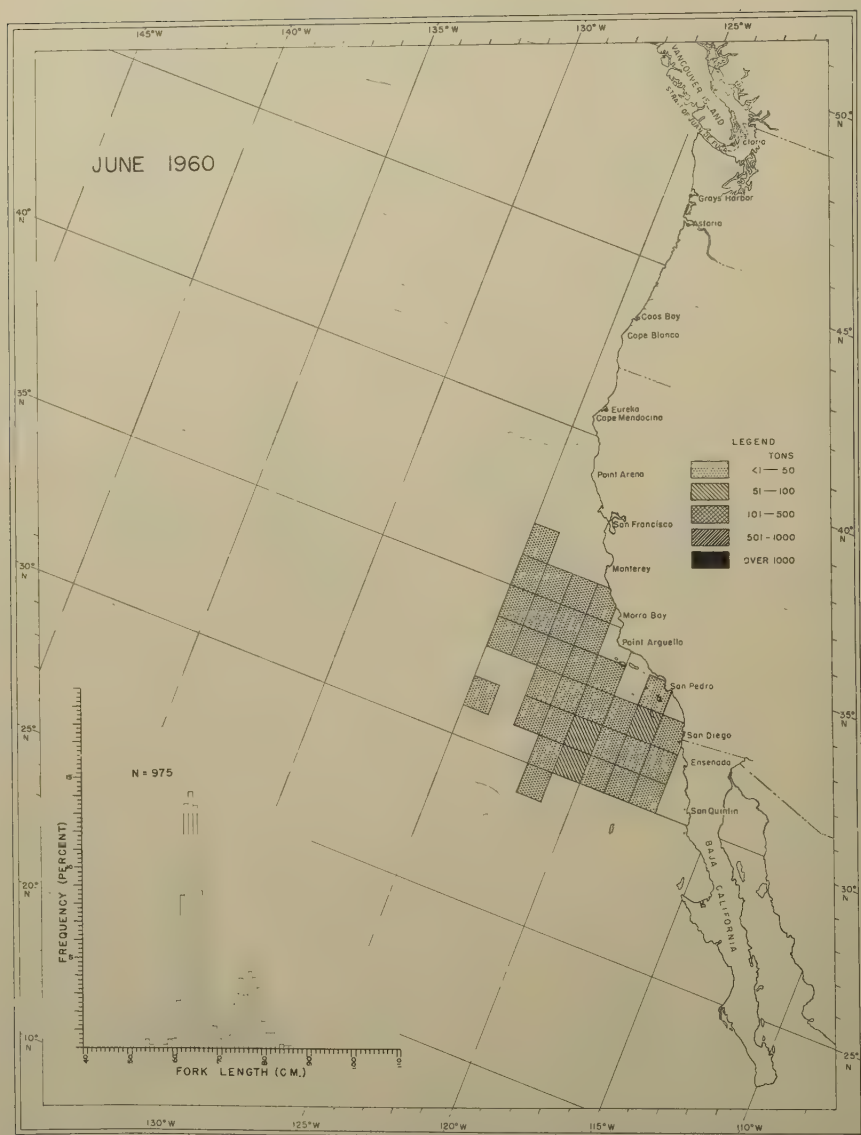


FIGURE 82. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

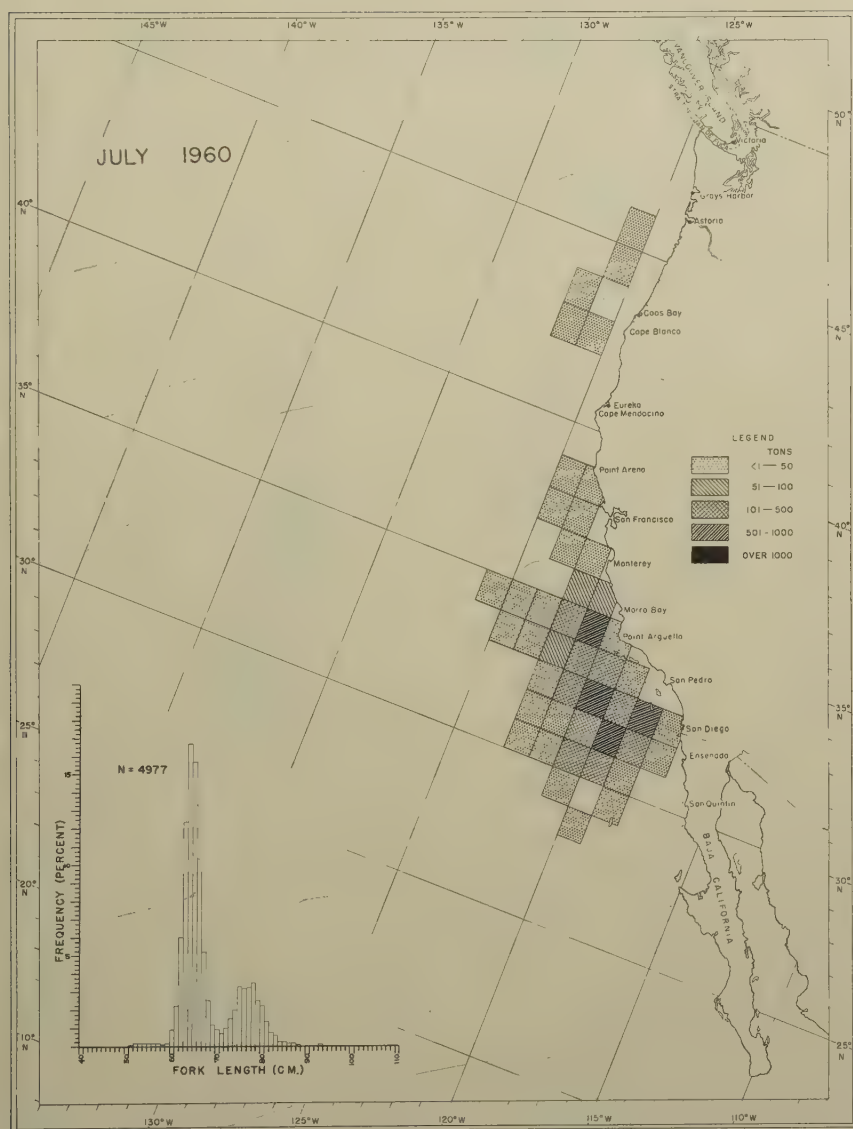


FIGURE 83. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

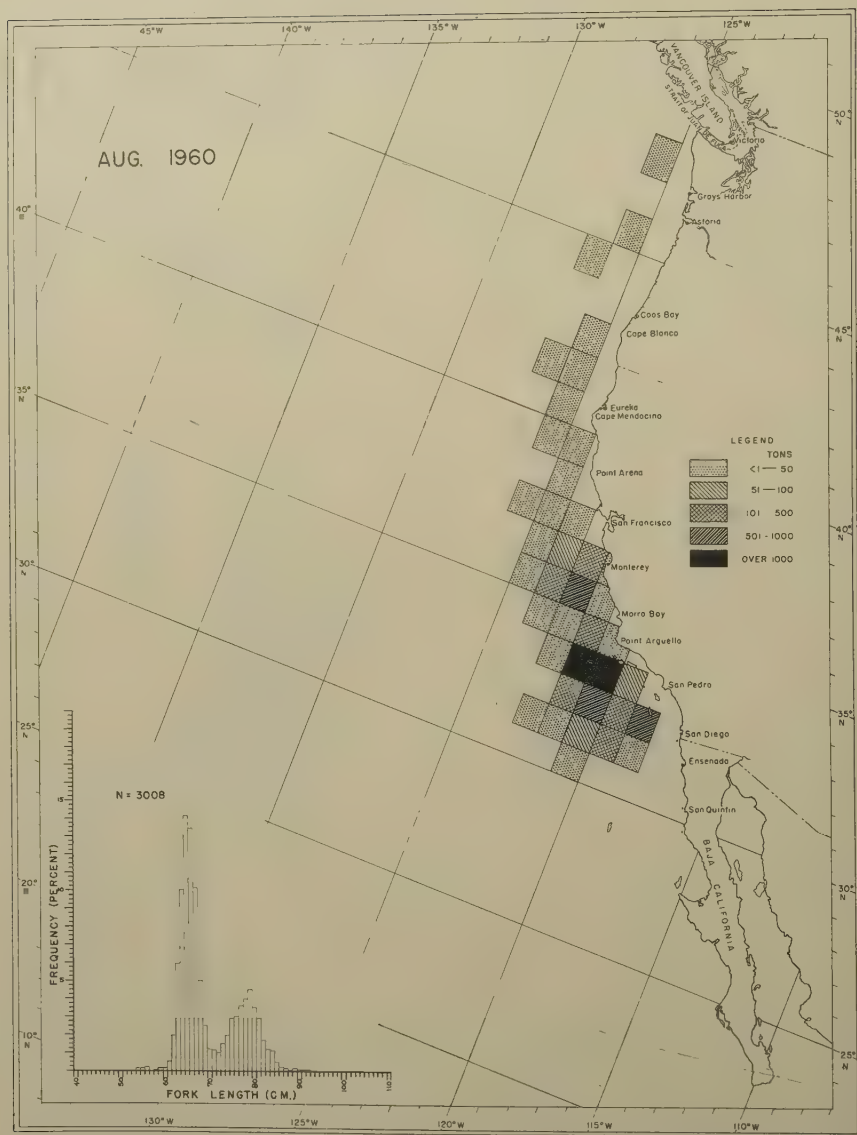


FIGURE 84. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

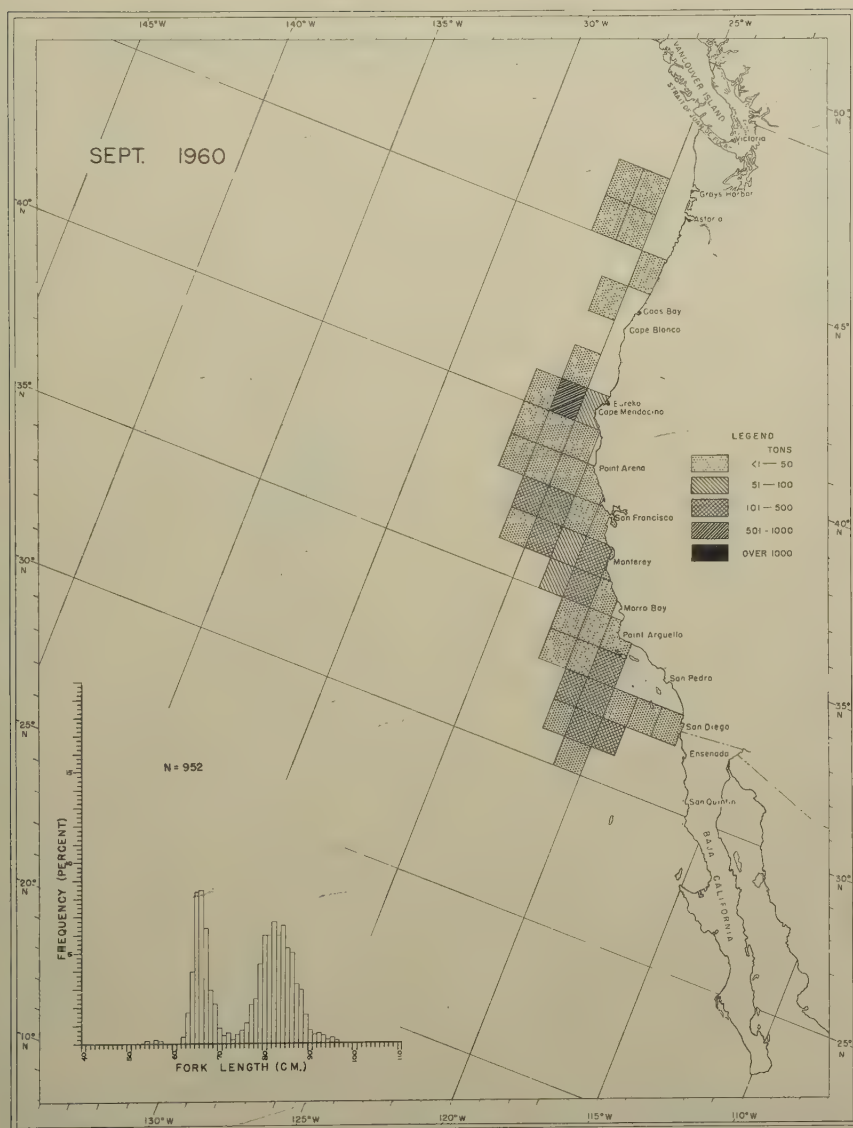


FIGURE 85. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

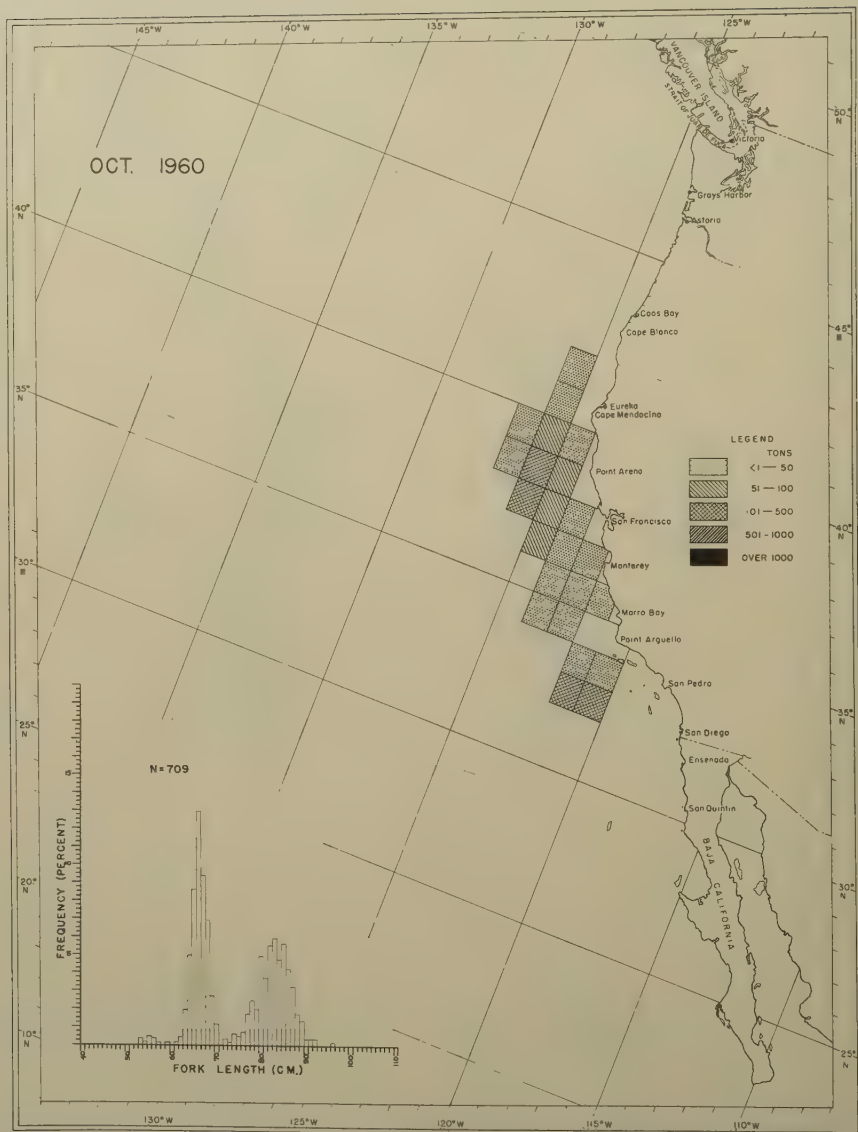


FIGURE 86. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

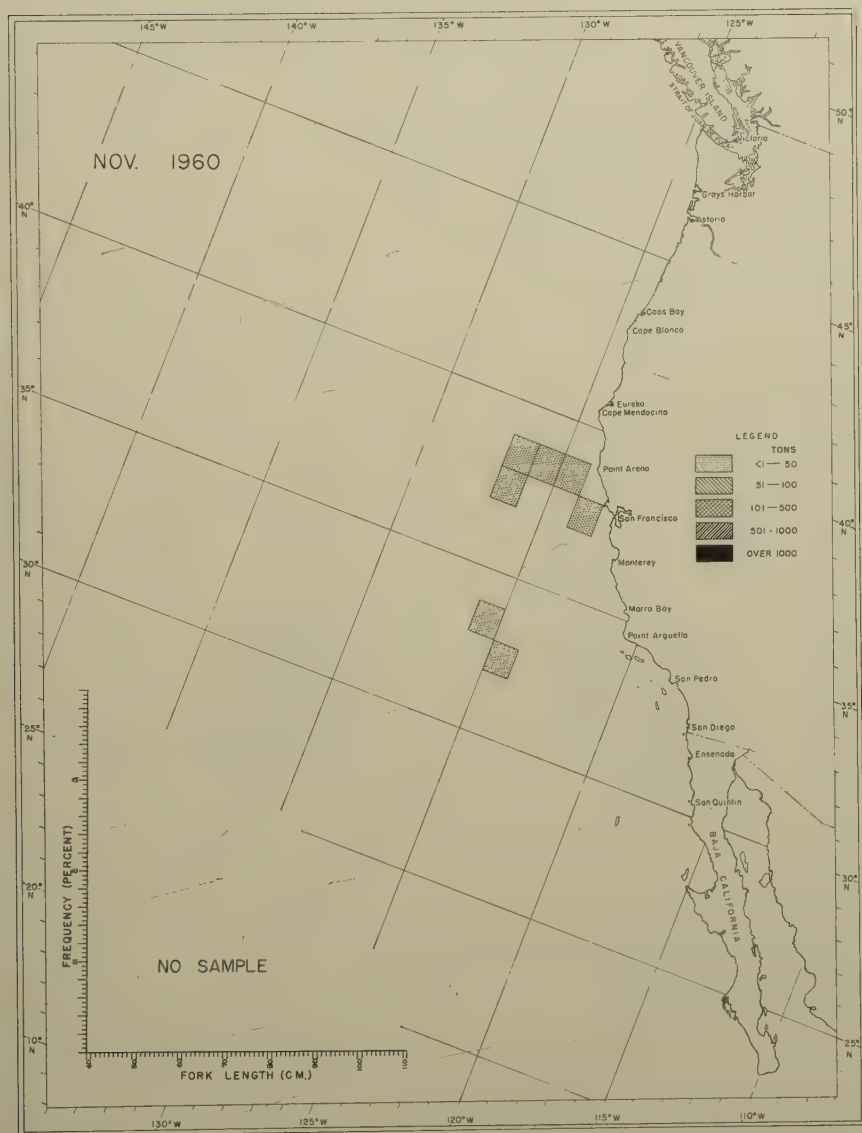


FIGURE 87. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

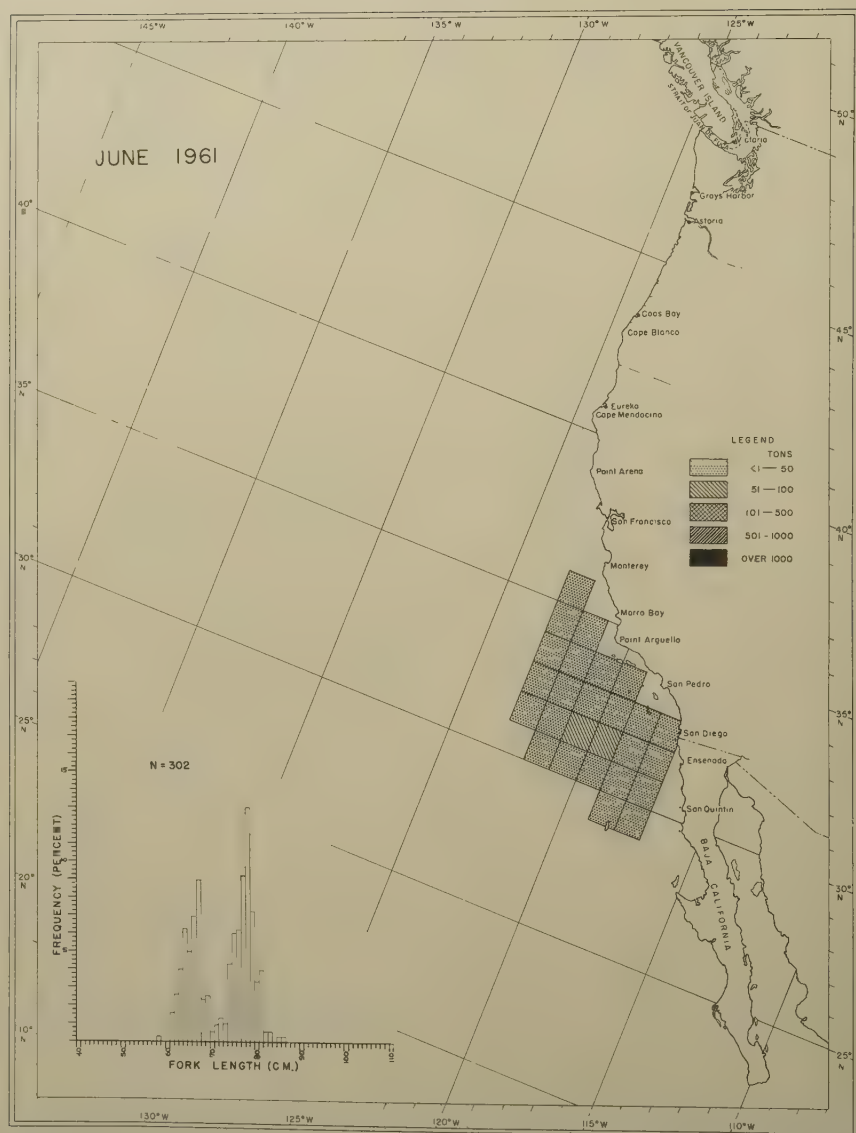


FIGURE 88. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

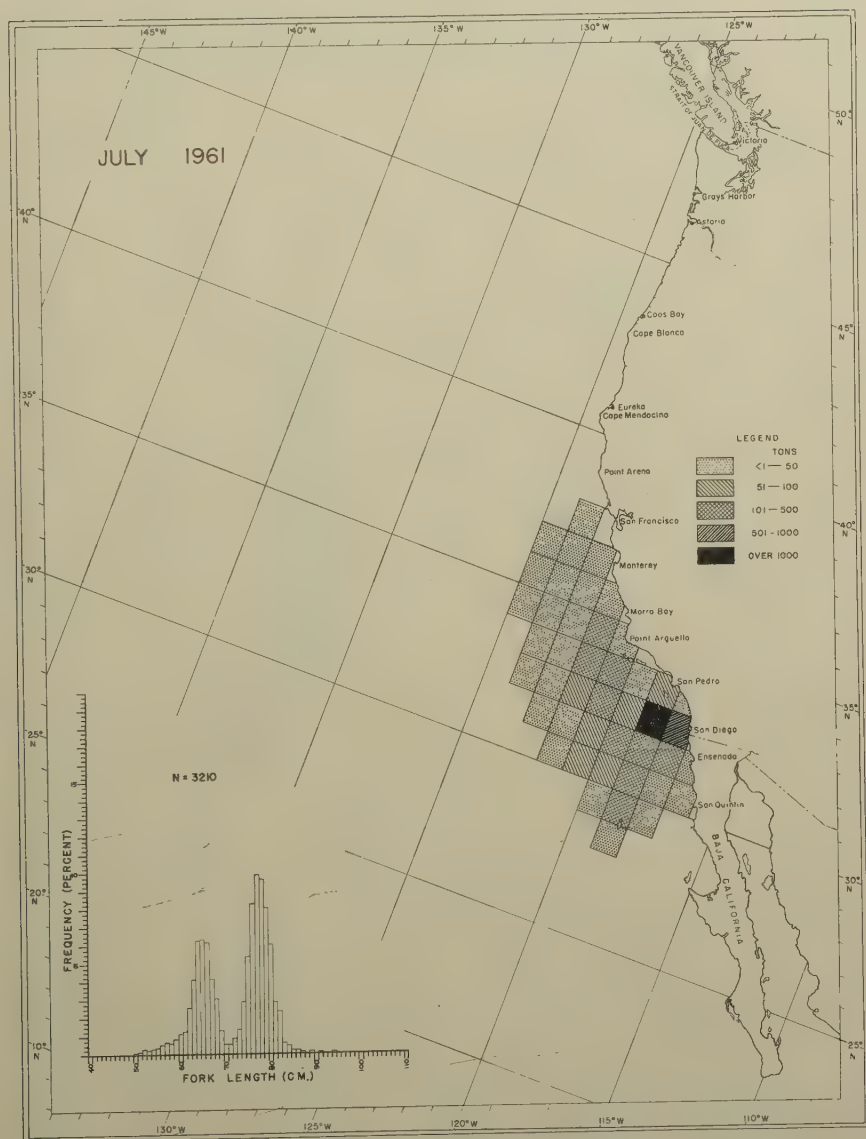


FIGURE 89. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

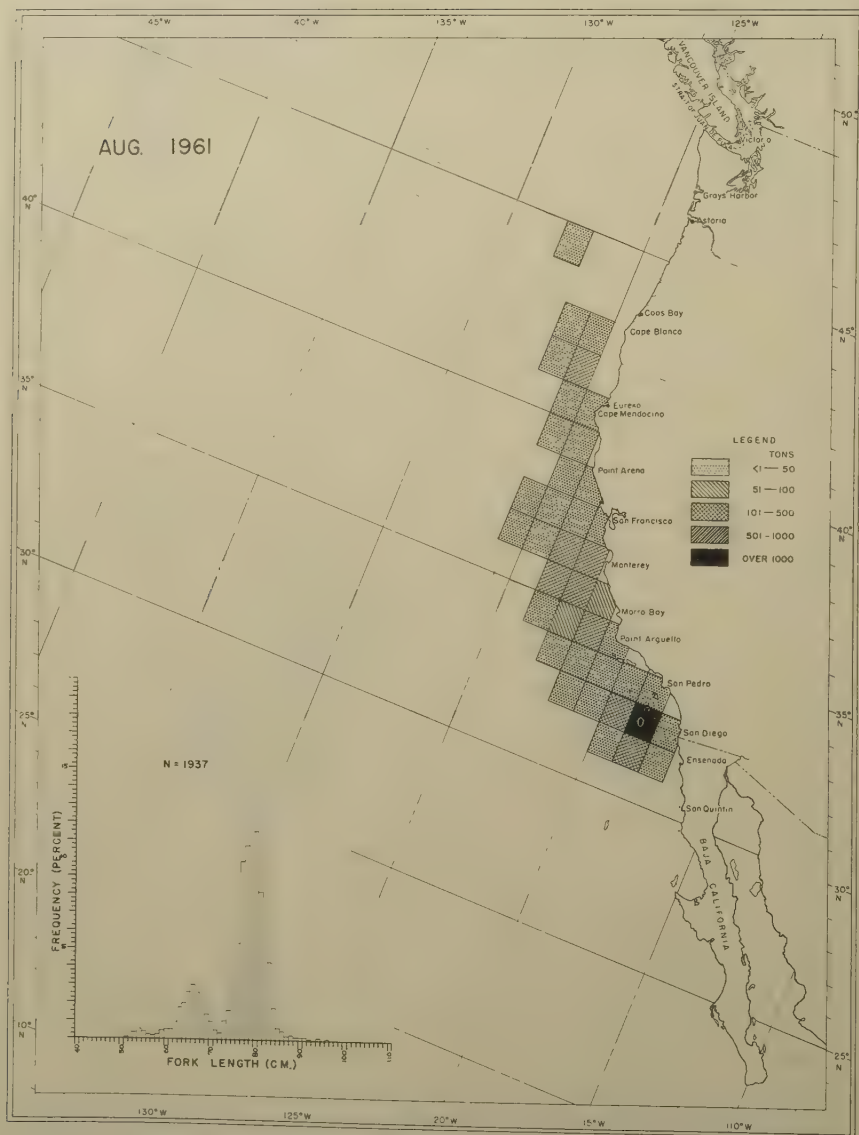


FIGURE 90. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

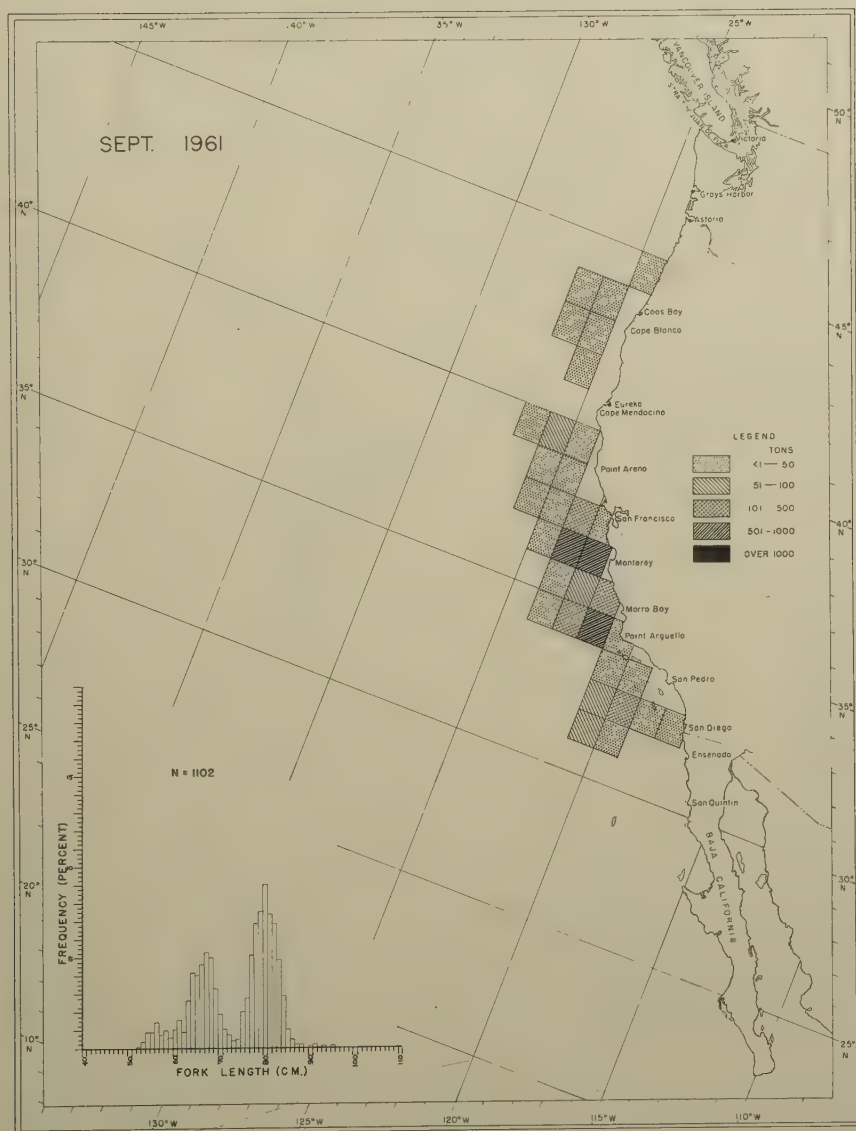


FIGURE 91. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

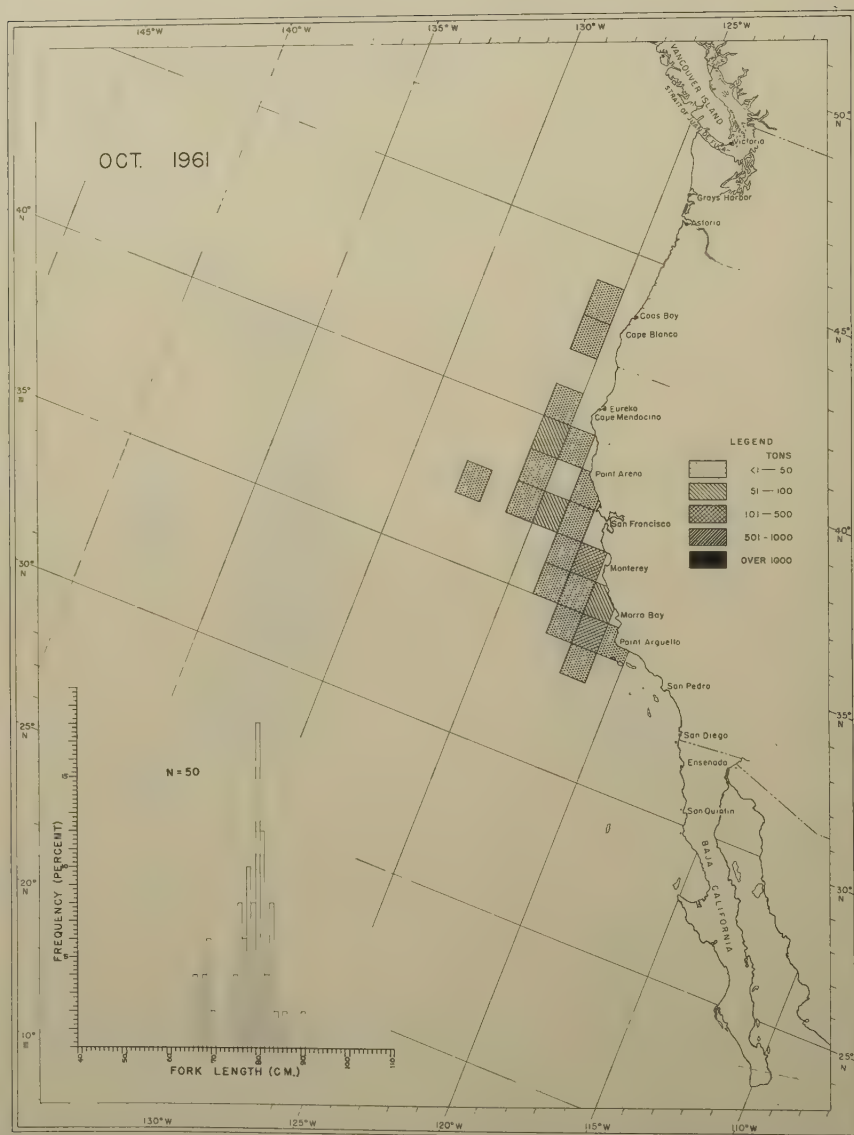


FIGURE 92. Albatross catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

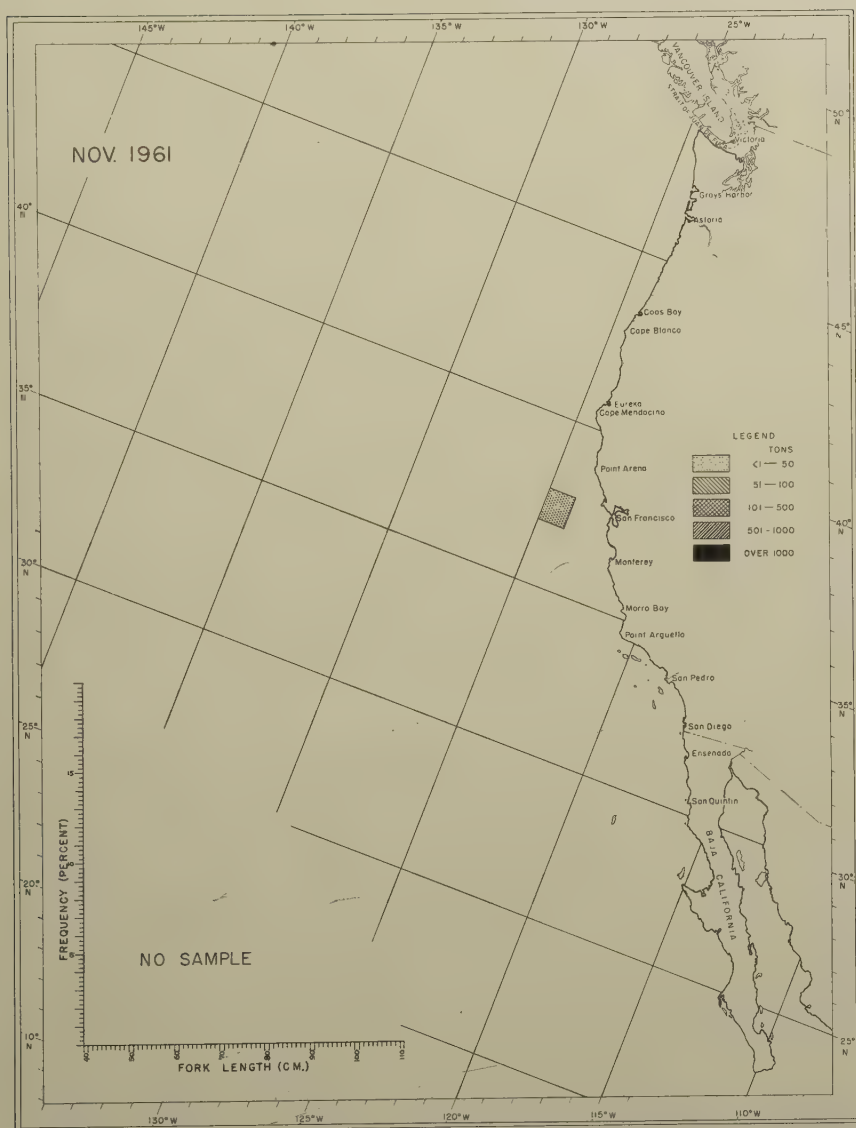


FIGURE 93. Albacore catch localities by one-degree squares for the California commercial fleet. Insert shows the length frequencies.

August (Figures 20, 26, 33, 39, 46 and 54) : The incoming migration ended, and the coastal trek northward was well advanced. The fleet attained its maximum size, and a portion of the fishery moved above Point Arguello. Although most fishing remained south of San Francisco, a few albacore were taken throughout the 1,000 miles between Cape San Lazaro, Baja California, and Eureka, California. This was the peak production month.

September (Figures 21, 27, 34, 40, 47 and 55) : Albacore were widely scattered, and good catches were found farther north than in August. Some albacore departed from the coastal grounds on their westward journey, and a few fishermen turned to other activities. The fishery's great northward progression was emphasized by a small harvest south of Guadalupe Island, and dwindling catches in most other southern areas.

October and November (Figures 22, 23, 28, 29, 35, 36, 41, 42, 48, 49, 56 and 57) : The westward offshore migration was well advanced, and many albacore already had entered Japan's winter longline fishing grounds west of the Hawaiian Islands. Numerous vessels left the California fishery, resulting in a sharp decline in fishing pressure and a marked shrinking of the albacore grounds—few heavily-fished localities remained. However, we should point out that fishing in these months was exceptional in 1955 and 1956, with catches made from south of Guadalupe Island, Baja California, to as far north as Eureka, California.

December to March (Figures 30, 43, 50, 51, 58, 59, 60 and 61) : Small numbers of albacore were caught near the southern grounds by skippers fishing other species for the fresh-fish market, and a slight trend toward heavier winter landings developed during the cold-water years. A few stragglers from each run overwintered locally and presumably joined forthcoming migrations.

Inshore and Offshore Migrations

Eastward-traveling albacore schools entered our fishing grounds in June; their number peaked in July, and the incoming, transpacific migration ended in August, a time when most "longfins" were fished south of Point Arguello. Substantial longitudinal shifts in the coastal run occurred during these three, prime fishing months. In general, albacore swimming near the coast while navigating the relatively calm, stormless seas south of Point Arguello yielded a better commercial harvest and an abundant sport catch compared to runs that developed far offshore. Regardless of whether schools ran inshore or off while on the southern grounds, once above Point Arguello they provided good fishing fairly close to land.

The role sea temperatures play in marine fish distribution and availability has been well documented (Radovich, 1961, 1963a; Clemens, 1961b), and additional supporting evidence is reported continually. Albacore react to certain temperature changes depending upon their size or age; small fish (< 20 pounds) abound in temperatures of 60° – 65° F (15.6° – 18.3° C), while 66° – 70° F (18.9° – 21.1° C) water produces mostly larger ones—measures in degrees fahrenheit are indicated because our fishermen use such thermometers. We hypothesized that the rate and manner in which seasonal sea-surface warming advances along

the Baja California coast are decisive in concentrating albacore and determining where they travel. Thus, sufficient heating of the coastal areas during an albacore run would cause them to swim northward far to sea, while a lack of heating would permit them to move fairly close to shore. Accordingly, our attention focused on the warm temperatures progressing from south to north along Baja California and southern California (Calif. Mar. Res. Comm., Atlas No. 1, 1963), and their effect on albacore movements during the interval June–August.

To study this phenomenon, we selected 19°C (66.2°F) and 14°C (57.2°F) isotherms to represent warm and cool seas respectively, because they were convenient and illustrated our ideas fairly well. An inshore run was defined as one in which albacore schools entered the fishing grounds on the south and then swam upcoast between longitude 119°W . and the land mass. An offshore run took place when the incoming schools turned and traveled northward west of longitude 119°W . Using these definitions for the six cold-water seasons, there were inshore runs in 1951 and 1952; offshore runs in 1953 and 1954; and inshore again in 1955 and 1956.

Inshore Runs, 1951 and 1952 (Figures 20 and 26): In June and July, temperatures warmer than 19°C remained far south of the fishing grounds; sufficient heating did not advance to hold the migration offshore or to push it northward (Figures 19 and 25; also see Figs. 94a and b). By August, a warm temperature-tongue had extended upcoast nearly to the Mexican border. We believe it exerted a "pressure" on the albacore schools, moving them northward and holding many of the smaller incoming fish away from coastal areas. However, it apparently did not inhibit the relatively few large fish from continuing their coastward journey. Warm tongues also concentrated albacore at times, and frequently provided good fishing near the frontal margins between warm and cool water.

Offshore Runs, 1953 and 1954 (Figures 33 and 39): Compared to the previous 2 years, warm temperature-tongues protruded northward between Guadalupe Island and the mainland, reaching above latitude 30°N . as early as July (see Figures 94c and d). This early-season heating caused most of the incoming schools to swing upcoast well offshore during July and August. The June migration leaders that arrived prior to the advancing warm temperatures and a few of the large albacore, more tolerant of warmer water, provided only meager coastal fishing.

Inshore Runs, 1955 and 1956 (Figures 46 and 54): Warm temperatures remained to the south in June and July and, as in 1951 and 1952, the incoming albacore migration turned and ran northward fairly nearshore (see Figures 95a and b). Unfortunately no comparable temperatures for August were available.

Cold sea temperatures also were important, for we found that albacore tended to avoid water cooler than 14°C during their incoming and coastal migrations. Such temperatures slowed the northward-moving schools or encouraged them to seek more favorable conditions outside of the cool coastal areas extending from Point Arguello to the Columbia River. When northward-moving albacore overtook the cold water their rate of travel was retarded, and they tended to concentrate near the

boundary between cool and warm seas. Good catches sometimes were made along these "thermal fronts."

In brief review: 1948 ushered a 9-year, cold-water era into the California albacore grounds—the longest string of cool years ever experienced by the fishery. During this era, the records for years 1951–1956 show that incoming schools entered our grounds near the southern margin and, depending upon sea temperatures, swung upcoast either offshore or inshore.

WARM-WATER SEASONS: 1957–1959

(Figures 62 through 81)

Description of the Months

For the warm years, our discussion of "typical" months is limited primarily to differences from the cold seasons, to avoid unnecessary repetition.

June (Figures 62, 70 and 76): Most catches occurred from Guadalupe Island to Monterey, California. Fishing to the south produced only a few scattered overwintering albacore; thus hundreds of miles of ocean, which in 1956 had produced heavily, became unproductive. At the same time, the location where albacore schools first penetrated the grounds, and the best fishing areas were much farther north compared to the cold Junes.

July (Figures 63, 71 and 77): Fishing was heavy, and the grounds expanded northward a considerable distance. In 1958, for example, they extended some 1,200 miles from Guadalupe Island to Vancouver Island, British Columbia. However, the largest catches were made below San Francisco within 250 miles of shore. Fishing south of Guadalupe Island showed no improvement over June.

August (Figures 64, 72 and 78): Warm-water Augusts were very much like the warm Julys. Fishermen made very good catches as far north as Vancouver Island and offshore to 200 miles. Fishing along the Baja California coast and southwest of Guadalupe Island was only fair in 1957 and failed in 1958 and 1959.

September (Figures 65, 73 and 79): There were heavy-catch areas off central California and fair catches were made north of the state, but little fishing occurred in the southern California Channel Islands area or south of the Mexican border. By comparison, cold Septembers during seasons having inshore runs, provided a much better harvest in the southern grounds, while catches north of the state were made only in 1956.

Fall and Winter Months (Figures 66, 67, 68, 69, 74, 75, 80 and 81): The fishing area diminished in size, and operations finally ended. Unusual October catches from Eureka northward in 1956 may have heralded the coming of warm water in 1957.

Discussion (1948–1959)

During the first 3 months in cold seasons 1948–1956, the incoming migration entered American grounds off Baja California. The warm years 1957–1959, by comparison, were completely different; winter and spring temperatures over much of the northeastern Pacific were unusually high and then climbed higher during the fishing months. This dramatic ocean heating displaced the transpacific migration route sev-

eral hundred miles northward, and by August 1958, albacore runs were practically eliminated south of San Pedro, California (Figures 72, 73, 78 and 79).

Year 1957 introduced unusually warm water to our fishing grounds and many tropical species appeared for the first time since 1941 (Radoovich, 1961). By June, warm temperatures ($> 19^{\circ}\text{C}$) were noted immediately below Guadalupe Island by our research vessel *N. B. Scofield*, and leaders of the incoming albacore migration were discovered entering the fishing grounds north of it instead of far to the south as during cooler years. In July, when the eastward migration was in full force, biologists aboard the *N. B. Scofield* found that warm temperatures had advanced north and along the coast to southern California. Good fish concentrations were located in and near the warm-water border area as it advanced. Meanwhile, temperatures 14°C and cooler had placed a northern boundary upon the albacore movements. This held some of the northward-traveling leaders south of San Francisco and pushed others 100 miles offshore—see Figure 95c.

Sea temperatures in August and September 1957 were not adequate for comparison, but postulating from catch data, a warm-temperature advance pressured the migration's southern portion rapidly upcoast; at the same time, a northern cold-water boundary persisted through September. It slowed this part of the migration, and thus albacore schools became concentrated between the two, from Point Arguello to San Francisco. As a result, fishermen reaped a record September harvest (Figure 65). During October and November, cold water was closer to land, and fishing began to wane as more and more albacore continued upcoast and then emigrated from our shores. Some overwintered, for catches off southern California and near Guadalupe Island persisted (Figure 68 and 69).

In 1958, the June and July 19°C isotherms extended a considerable distance above Guadalupe Island, holding the incoming migration north of latitude 31°N .—see Figure 95d. The small number of fish caught inshore and below this area were overwintering from the 1957 season, as further evidenced by results of Cruise 58A-3 of our research vessel *Alaska*. August-October temperature data are lacking, but warm water apparently had advanced to Point Arguello by October, for the fishery had moved north of there (Figure 74).

The warm-water regime reached its peak in 1959 (Figure 9). However, in June, the sea off southern California had cooled and the 66°F (19°C) isotherm was below Point San Eugenio, Baja California—see Figure 103. The June migration leaders did not move in toward the south (Figure 76) with this transient cooling; instead, albacore entered the fishing grounds off southern California as documented by Cruise 59S-4 of the *N. B. Scofield* and Cruise 52 of the *Hugh M. Smith* (Craig and Graham, 1961). In July, sea temperatures climbed rapidly and warming spread northward. This temperature advance was sufficient to limit southern fishing, while cooler water to the north curtailed inshore catches above Monterey—see Figure 104. Temperatures sufficiently warm to influence albacore movements continued to advance during August and September 1959, and the albacore fishery moved upcoast as far as Vancouver Island (Figures 78 and 79). In October

and November, coastal catches on the north were limited by 58°F (14°C) and cooler water near Cape Mendocino, California.

To review the warm-water seasons briefly: Unusually high ocean temperatures in 1957 ended the cold-water era. The albacore migration and the fishery were displaced northward, eliminating the grounds below Guadalupe Island. In 1958, increased warming affected the entire Baja California fishery, and very few tons were landed compared to several hundred taken seasonally during the cold era (1948-1956). Additional heating in 1959 resulted in complete failure south of California.

COOLING YEARS: 1960-1961

(Figures 82 through 93)

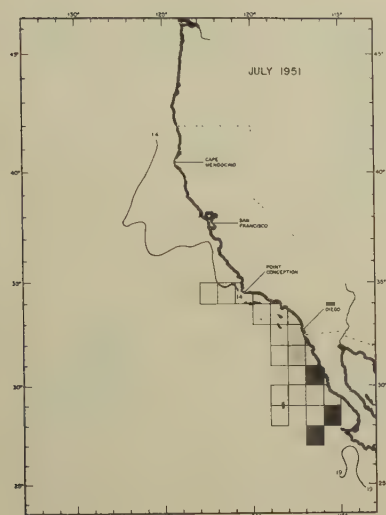
Sea temperatures dropped below average (Figure 9); the transpacific migrators moved into the grounds farther south than they had during the previous warm seasons (documented for 1960 by *N. B. Scofield* Cruise 60S-3 [Craig and Caneday, 1962], and in 1961 by *N. B. Scofield* Cruise 61S-3, *Alaska* Cruise 61A-4, and Cruise B6106 of the U.S. Bureau of Commercial Fisheries vessel *Black Douglas*). Fishing north of the state declined—see Figures 110 and 117. This southern shift improved catches significantly between the latitudes of the Mexican border and Guadalupe Island (Figures 83 and 89), and the fishing grounds during these 2 years resembled those in 1957. The 66°F (19°C) isotherm was south of Pt. San Eugenio, Baja California, during June 1960 and 1961, and if seasonal warming had not advanced rapidly in July and August we believe a fishery might have developed below Guadalupe Island. Instead, these grounds failed to produce for the fifth consecutive year.

In 1961, 13-pound albacore (65 cm), which had been the mainstay of the industry for many years, did not migrate into the grounds in their usual abundance. At the same time, larger fish arrived in exceptional numbers (Figure 16d) and dominated the catch for the first time since World War II. We are not certain what caused these changes.

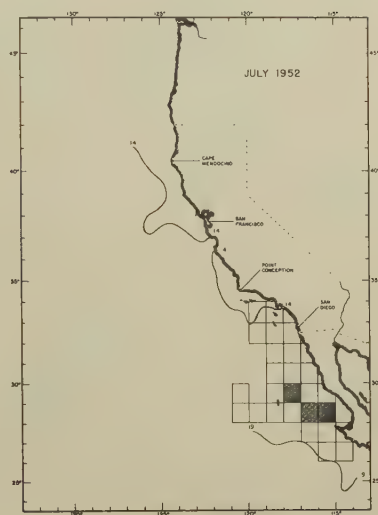
CATCH ANALYSIS

Although albacore occur throughout the world's temperate seas, we are concerned primarily with those inhabiting the North Pacific. Information obtained from tagging indicates there is a single population in the area. While proceeding under this assumption, we are testing it by conducting additional population differentiation studies using electrophoretic techniques developed by Smith (1962).

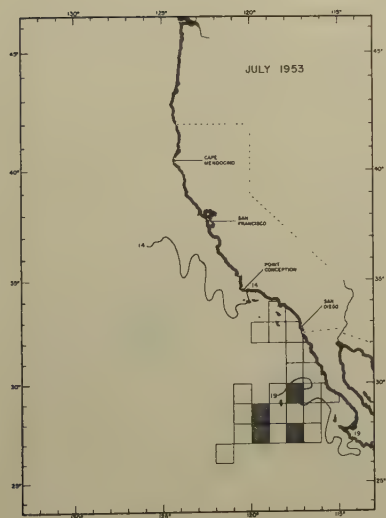
Another task is to determine, on a continuing basis, the size of the Pacific-wide population and total quantity harvested by the various fleets. This can be accomplished best through interstate and international exchange of pertinent data, because information encompassing the population's entire geographic range is necessary for meaningful analysis. Steps toward this goal recently have been initiated on an informal basis by several research agencies, and we anticipate good results in the near future. Our responsibility in the cooperative endeavor is to investigate the population segment seasonally migrating



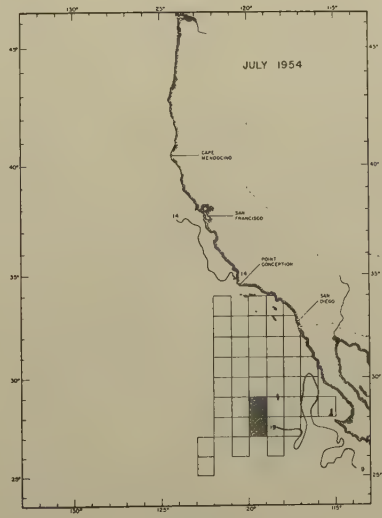
(a)



(b)



(c)



(d)

FIGURE 94. California commercial albacore catch localities in July compared with selected sea-surface isotherms. Darkest areas represent catches over 500 tons.

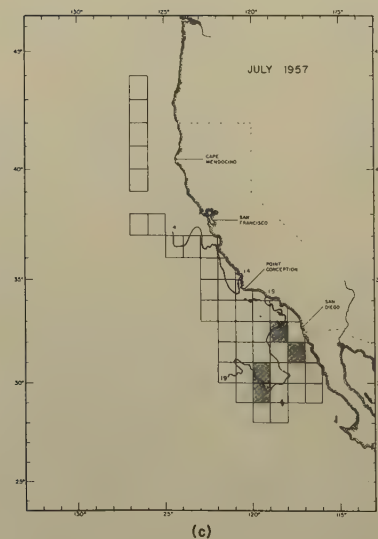
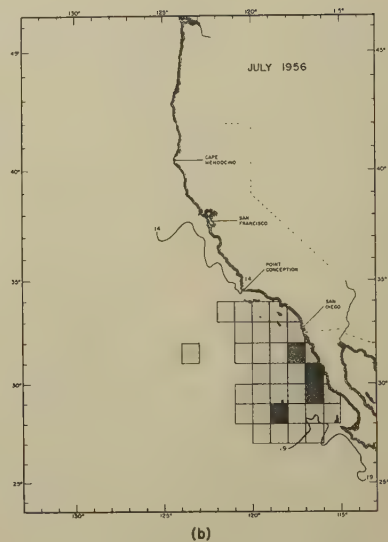
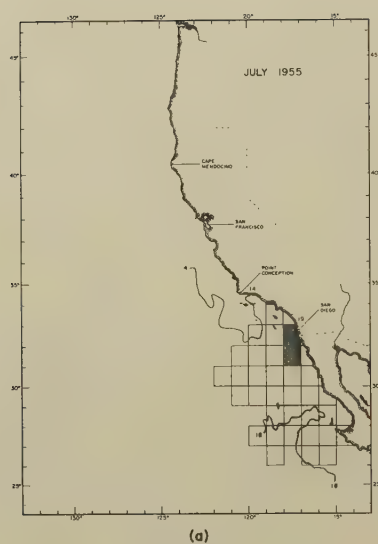


FIGURE 95. California commercial albacore catch localities in July compared with selected sea-surface isotherms. Darkest areas represent catches over 500 tons.

through California fishing grounds, to document the ensuing fishery, and to make the results available.

We have studied the migration directly through combined oceanographic and exploratory fishing surveys aboard research vessels and indirectly by sampling the fishing fleet. Research cruises provided quantities of valuable information, and proved indispensable for making field observations and testing various hypotheses. However, since these vessels are expensive to operate, and the observations obtained were not as synoptic as desired, we relied upon the tremendous albacore fishing fleets for much of the required data.

The Commercial Fishery

"Pink Ticket" Analysis

Responsibility for maintaining complete and accurate records of all fish landed and sold in California resides in the statistical unit headquartered at the State Fisheries Laboratory, Terminal Island (Calif. Dept. Fish and Game, 1952). Sales receipts, required by law and popularly called "pink tickets," are the foundation of the record system; each contains such information as species caught, total weight, price, general catch origin, date fish were landed, fishing gear, vessel name, and registration number. In the case of albacore, pink tickets were the only source of historical catch data for years prior to 1951. Therefore, tickets representing the 32-year period 1931-1961 were utilized to investigate annual changes in production, fleet size, amount of fishing, and harvest rate—though they provided only gross measures.

The number of vessels in the albacore fleet and their catch were summed directly from the tickets. The harvest rate was calculated from the landings and corresponding fishing effort, which were determined each year based upon the following rules: records from skiffs, small tenders, vessels longer than 80 feet, and all boats landing 100 pounds or less in a season were culled because they were not typical. The remainder, comprising 93 percent of the fleet, was assigned one boat-month of fishing for each calendar month in which they landed albacore, except for those operating at the beginning and end of a season when fishing was less intense. Vessels delivering their fish during a season's first month, usually June, were credited with a minimum assigned fishing time of one-half a boat-month, as were those landing albacore after the first 4 days in the final month of each season—whatever it might have been. Boats landing fish only once during the first 4 days in a season's last month were not credited with fishing effort that month.

Fortunately we were able to compare these results with more detailed logbook data for an 11-year period (1951-1961), and the pink tickets proved quite reliable for measuring long-term trends in the fishery—see discussion following the logbook analysis section. The records show that annual albacore landings rose gradually to a 1950 high of over 60 million pounds and then moved erratically downward. The number of vessels also peaked in 1950; but since then many captains, including novices and experienced ones alike, abandoned the fishery and a successively smaller fleet was unable to generate enough fishing pressure to keep the total catch from moving lower. Despite this downturn, the "selected" fleet maintained landings at compara-

tively high levels, averaging 33 million pounds from 1951-1961 inclusive (Figure 96). Total time spent fishing (intensity) increased from 76 boat-months in 1931 to 8,224 months in 1950 and then went into an 11-year decline. It was caused by seasonal changes in num-

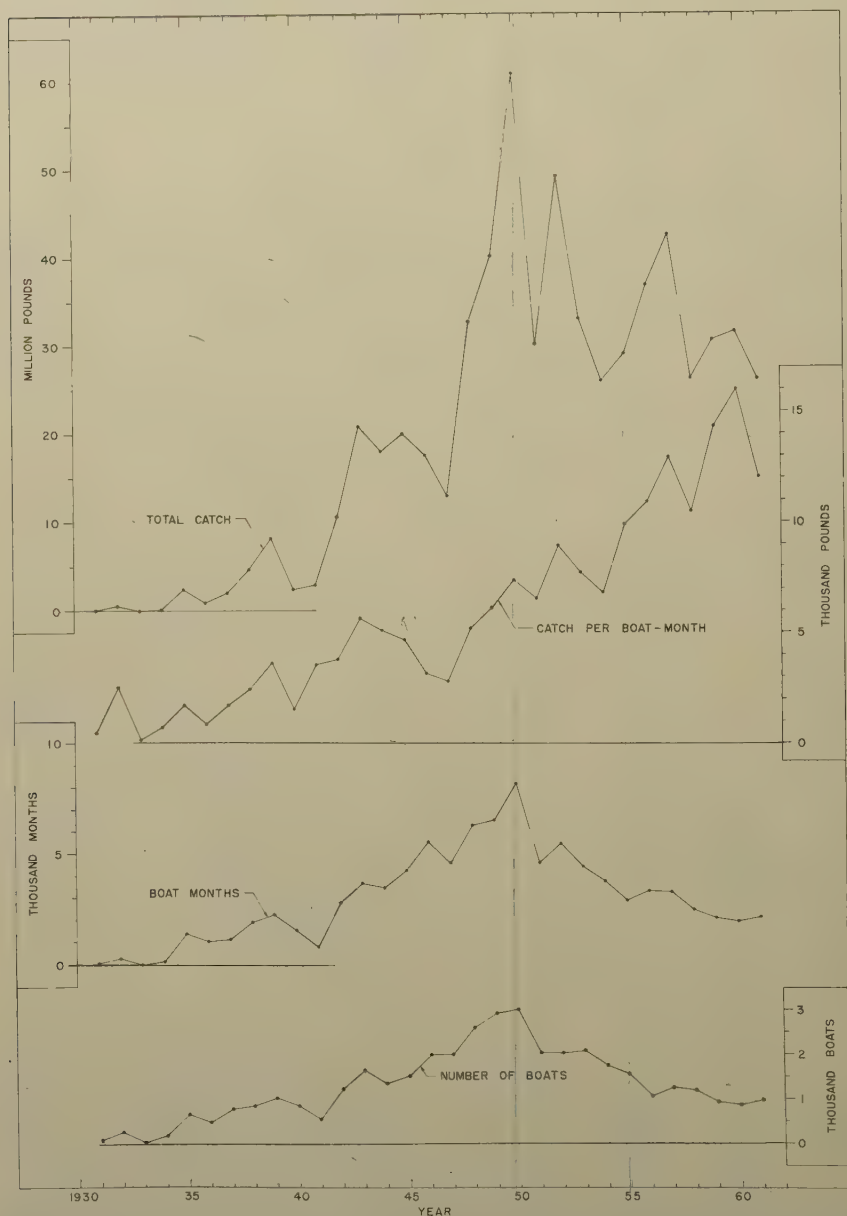


FIGURE 96. Selected statistics of the California commercial albacore fishery from sales receipts ("pink tickets"). Appendix F.

ber of vessels which in turn were due partly to the economic climate (Figure 97). The harvest rate (catch-effort) fluctuated while climbing upward from 468 pounds per boat-month in 1931, to 12,025 pounds in 1961 (Figure 96). We feel that changes in the migration route, distance fishermen operated from shore, size of the run, average fish weight, or combinations of these at one time or another since 1931 caused major fluctuations in the harvest rate.

To gain insight into the size of California's albacore migration and to measure what effects the environment and the fishery have had

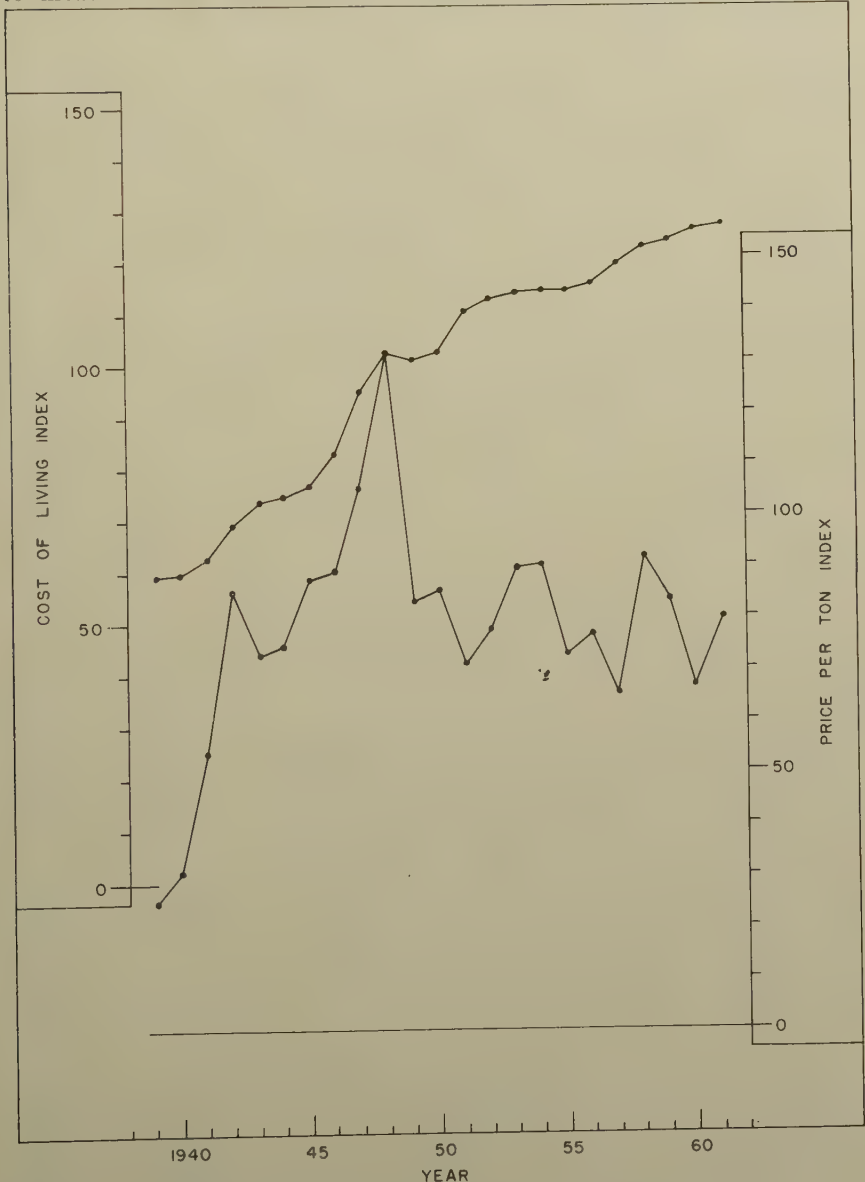


FIGURE 97. U.S. Labor Department cost-of-living index (1947-1949 base) compared to price-per-ton index for the California albacore fishery. Appendix G.

upon it, more detailed information was needed than pink tickets alone could provide. Therefore we turned to fishermen's logs.

Logbook Analysis

Since 1950, the fleet has averaged well over a thousand vessels, with fishermen delivering their bountiful harvest to ports scattered for hundreds of miles along the vast coastline from San Diego to Crescent City. The expense involved in sampling such a fleet precluded gathering data from all boats every trip, so a sampling plan was initiated in 1951. It provided for field personnel to interview captains unloading at California's major albacore ports and obtain dates of departure and return to port, specific locations fished, quantity of albacore caught each trip, and vessel names and registration numbers. In 1954, fishermen were issued specially-designed logbooks, and completed logs for each trip were then combined with the pink tickets into a single system. This was implemented for better coverage of the fleet and to obtain detailed information about each day's fishing. To handle the increased quantity of data thus produced, the system was adapted to International Business Machine (IBM) tabulation and has been used successfully since then, with only slight modification.

The logbooks contain tear-out charts of the fishing grounds. Each chart is divided into one-degree squares of latitude and longitude because this area is consistent with accuracy in navigating; small enough to bring out major features in the fishery; comparable between months and seasons; and adaptable to numerical processing, by coding the latitude and longitude in the southeast corner. For example, code "34-120" describes an area bounded by latitudes 34° and 35° N. and longitudes 120° and 121° W. During each trip, fishermen plot their daily activities on one of the charts, giving information on areas fished, number of albacore caught, sea temperatures, and any additional remarks the captains felt were pertinent (Craig, 1963).

From 1951 through 1953, the pounds landed each trip were assigned to month of catch and to one-degree squares; the effort—in days fishing—was calculated using days absence from port (Figure 98). From 1954 through 1958, the number of fish caught each trip also was assigned by catch month to one-degree squares, and the days fished were summed directly from the logs. During 1959 through 1961, the system was improved further by assigning effort to one-degree squares each month along with the catch. For all 12 years, the catch-per-day was obtained in terms of pounds and numbers.

The results permitted a more complete analysis, including details of where, when, and how many albacore were caught, improved measures of fishing effort, and information about albacore-environmental relationships. In addition, we used the average catch-per-day, in number of fish, as an index of size for each migration, assuming that fishery independent and fishery dependent factors within a season have not significantly biased the data.

Albacore have been harvested from trollers and live-bait boats, of various sizes, skippered by personnel having different fishing experience. To date, we have been unable to demonstrate that efficiency is significantly affected by the variations in gear, vessel size, or experience (Abramson, pers. comm.); therefore our effort figures have not

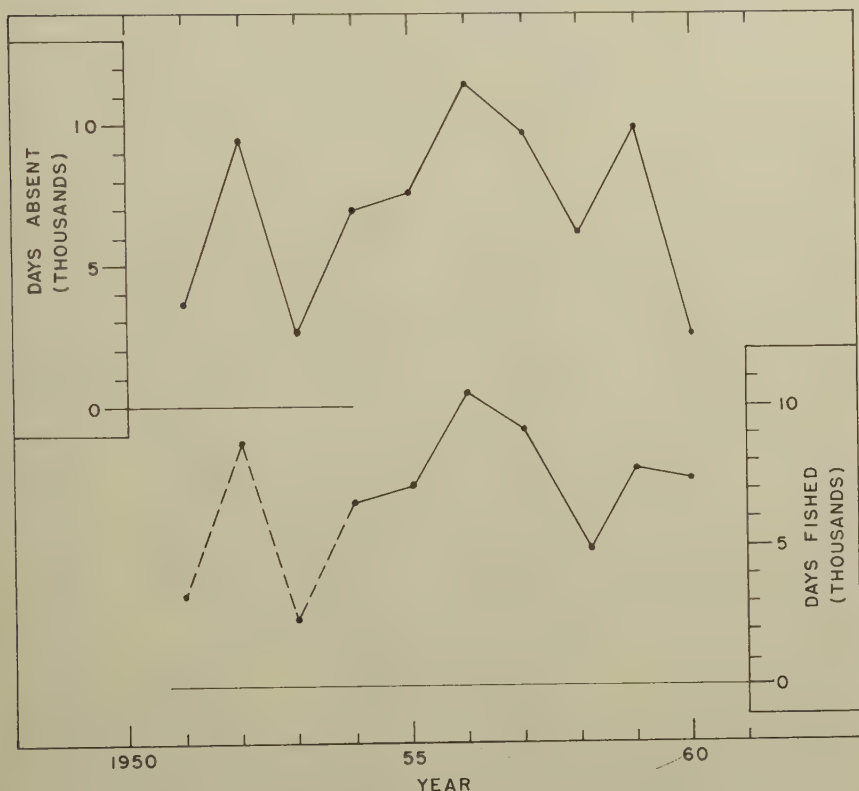


FIGURE 98. Commercial albacore fishing effort measured in days absence compared with effort measured in days fished. Data from the California fleet logbooks.

been adjusted. Purse seiners, however, were not considered a part of the albacore fleet, so their substantial catches in 1960 and 1961 (Table 2) have been eliminated.

The vessels from which we obtained logs comprised the "sample fleet." It varied in size each season, and its proportion of the total catch fluctuated from about 10 percent at the outset of our sampling system to as high as 39 percent in later years (Table 5). We assumed the sample fleet's catch statistics represent the entire California fleet; therefore they were used to prorate the seasonal landings into month of catch by one-degree squares (Figures 18 through 93). During the period 1951 through 1953, only the deliveries to selected ports were assigned to one-degree squares by month (Clemens, 1955). For this paper, however, we prorated the total catch for those years.

Pink tickets revealed that year 1950 was a significant turning point in the fishery, and although logbooks were unavailable, we made some comparable estimates based partly upon succeeding years. (The number of fish caught was determined by utilizing the landing weight, length frequencies, and length-weight tables; total days fishing was estimated by direct proportion from an average of the 1951-1952 data.) These figures gave some idea of the events in 1950, and provided a

TABLE 5

**Monthly Sample Size Compared to the Magnitude of the Commercial
Catch and Landings, 1951-1961**

<i>Fishing season</i>	<i>Commercial landings (lbs.)</i>	<i>Commercial catch (lbs.)</i>	<i>Sample (lbs.)</i>	<i>Percent sampled</i>
1951				
Jun. -----	157,917	1,225,188	95,656	7.8
Jul. -----	7,488,951	10,698,033	1,176,006	11.0
Aug. -----	14,317,692	11,136,088	1,546,968	13.9
Sep. -----	4,450,082	6,128,414	225,984	3.7
Oct. -----	3,813,082	1,171,844	10,939	0.9
Nov. -----	648,359	516,516	11,040	2.1
Dec. -----	35,593	---	--- †	---
Total -----	30,911,676	30,876,083	3,066,593	9.9
1952				
Jun. -----	6,299	1,197,302	229,851	19.2
Jul. -----	11,735,178	13,332,107	2,513,838	18.9
Aug. -----	15,836,924	19,472,538	2,932,921	15.1
Sep. -----	11,718,805	5,295,259	569,495	10.8
Oct. -----	7,571,819	8,854,662	46,049	0.5
Nov. -----	2,405,978	1,646,154	154,180	9.4
Dec. -----	528,521	5,502	1,290	23.4
Total -----	49,803,524	49,803,524	6,447,624	12.9
1953				
Jun. -----	97,258	866,038	48,299	5.6
Jul. -----	9,171,814	10,227,249	664,112	6.5
Aug. -----	11,422,084	13,788,490	1,432,221	10.4
Sep. -----	11,115,104	7,426,940	1,204,648	16.2
Oct. -----	1,940,715	1,512,369	74,359	4.9
Nov. -----	88,930	14,819	2,244	15.1
Total -----	33,835,905	33,835,905	3,425,883	10.1
1954				
Apr. -----	1,065 *	---	---	---
May -----	640 *	---	---	---
Jun. -----	2,866	305,677	43,556	14.2
Jul. -----	7,505,842	9,771,050	1,450,595	14.8
Aug. -----	8,119,263	7,171,315	1,224,632	17.1
Sep. -----	7,638,344	6,968,513	1,372,343	19.7
Oct. -----	2,259,383	1,505,177	235,081	15.6
Nov. -----	491,551	345,642	55,909	16.2
Dec. -----	88,336	39,588	3,191	8.1
Jan., 1955 -----	1,377	0	0	---
Total -----	26,108,667	26,106,962	4,385,307	16.8
1955				
Jun. -----	16,002	223,696	51,383	23.0
Jul. -----	8,493,982	9,205,986	2,264,644	24.6
Aug. -----	7,203,181	8,229,957	1,762,047	21.4
Sep. -----	5,285,944	4,904,606	677,118	13.8
Oct. -----	4,053,530	3,793,862	407,244	10.7
Nov. -----	2,432,023	1,884,554	215,913	11.5
Dec. -----	1,516,259	787,510	98,202	12.5
Jan., 1956 -----	362,722	356,321	133,551	37.5
Feb. -----	22,849	0	0	---
Total -----	29,386,492	29,386,492	5,610,102	19.1

TABLE 5—Continued

Monthly Sample Size Compared to the Magnitude of the Commercial Catch and Landings, 1951-1961

<i>Fishing season</i>	<i>Commercial landings (lbs.)</i>	<i>Commercial catch (lbs.)</i>	<i>Sample (lbs.)</i>	<i>Percent sampled</i>
1956				
Jun. -----	210,517	2,781,048	811,110	29.2
Jul. -----	11,186,341	12,083,571	3,866,215	32.0
Aug. -----	10,115,668	8,821,770	2,920,126	33.1
Sep. -----	7,758,516	8,402,438	2,175,360	25.9
Oct. -----	4,681,705	2,531,539	467,556	18.5
Nov. -----	1,662,157	1,401,478	243,512	17.4
Dec. -----	1,054,736	737,541	95,257	12.9
Jan., 1957 -----	429,120	384,248	65,251	17.0
Feb. -----	58,705	24,457	9,154	37.4
Mar. -----	11,095	470	213	45.3
Apr. -----	370	---	--- †	---
Total -----	37,168,930	37,168,560	10,653,754	28.7
1957				
Jun. -----	511,799	1,341,953	334,850	25.0
Jul. -----	9,443,504	13,304,967	3,618,096	27.2
Aug. -----	10,687,667	8,683,768	2,393,735	27.6
Sep. -----	12,971,541	14,804,872	3,327,411	22.5
Oct. -----	7,045,428	3,765,841	558,968	14.8
Nov. -----	1,838,270	970,993	203,635	21.0
Dec. -----	527,746	153,769	53,504	34.8
Jan., 1958 -----	6,337	6,129	502	8.2
Feb. -----	1,843	---	--- †	---
Mar. -----	347	---	--- †	---
Total -----	43,034,482	43,032,292	10,490,701	24.4
1958				
Jun. -----	14,228	45,738	12,394	27.1
Jul. -----	7,150,165	12,601,406	3,264,885	25.9
Aug. -----	10,627,697	9,899,152	1,626,663	16.4
Sep. -----	6,038,085	3,119,370	417,202	13.4
Oct. -----	3,207,589	1,483,081	196,100	13.2
Nov. -----	129,020	30,503	16,383	53.7
Dec. -----	12,466	0	0	---
Total -----	27,179,250	27,179,250	5,533,627	20.4
1959				
Jun. -----	50,976	350,952	143,377	40.9
Jul. -----	7,789,600	8,709,208	3,881,729	44.6
Aug. -----	10,913,109	12,495,706	5,311,177	42.5
Sep. -----	8,829,606	10,026,085	3,066,414	30.6
Oct. -----	4,758,641	1,104,763	410,013	37.1
Nov. -----	390,519	45,737	17,110	37.4
Dec. -----	8,013	---	--- †	---
Total -----	32,740,464	32,732,451	12,829,820	39.2

TABLE 5—Continued
 Monthly Sample Size Compared to the Magnitude of the Commercial
 Catch and Landings, 1951–1961

<i>Fishing season</i>	<i>Commercial landings (lbs.)</i>	<i>Commercial catch (lbs.)</i>	<i>Sample (lbs.)</i>	<i>Percent sampled</i>
1960				
Jun. -----	126,383	1,017,746	484,940	47.6
Jul. -----	4,109,165	11,789,583	5,744,565	48.7
Aug. -----	18,245,400	13,395,426	5,553,021	41.5
Sep. -----	7,520,908	6,340,211	1,388,799	21.9
Oct. -----	3,762,017	2,340,043	373,399	16.0
Nov. -----	1,310,625	13,885	1,940	14.0
Dec. -----	38,129	0	0	---
Total -----	35,112,627	34,896,894 ‡	13,546,664	38.8
1961				
Jun. -----	35,603	883,591	392,084	44.4
Jul. -----	8,298,969	9,244,014	3,783,806	40.9
Aug. -----	10,033,657	8,685,968	2,334,414	26.9
Sep. -----	7,269,237	6,910,885	1,676,073	24.3
Oct. -----	3,302,651	1,434,974	360,075	25.1
Nov. -----	183,127	3,747	854	22.8
Total -----	29,123,244	27,163,179 ‡	8,547,306	31.5

* Caught off South America by California vessel; included only to balance totals.

† No sample.

‡ Purse seine catches excluded—see Table 2.

lead-off for presenting the more detailed analysis of each following season.

The California fishing fleet attained its maximum size of 3,161 vessels in 1950; these skippers fished about 63,000 days (173 boat-years)—an all-time high—and caught a record 4.5 million albacore weighing 61.7 million pounds (Table 6). The run was close to shore, and although it was only average in size, judging by the fleet catch of 73 fish per day, the unusual amount of time spent fishing resulted in a record harvest (Figures 99 and 100).

In 1951, the albacore price was low (Figure 97), and the fishery was dealt a staggering blow when nearly one-third (1,049) of the captains abandoned it (Figure 17). As a result, fishing intensity dropped almost 44 percent (75 boat-years) to only 35,000 days, and the catch plummeted to 30.9 million pounds (2.0 million fish)—a decline of 50 percent or more than 30.8 million pounds from 1950. In addition, the inshore migration was small, as evidenced by the fleet average of only 57 fish per day—a loss of 16 from the previous year.

During 1952, the second best season on record, participating vessels increased only slightly in number, but fishing intensity rose to 47,000 days for an increase of 31 boat-years compared to 1951. The migration was fairly large (70 fish per day), and it moved in close to shore where increased fishing raised production to 49.8 million pounds (3.2 million fish).

In the 1953 season, 314 fewer vessels fished than during the previous year, and intensity fell 27 percent (35 boat-years) to 34,000 days. The run was fair-sized (69 albacore per day), and although it stayed

TABLE 6
California Commercial Fishing Statistics Compiled from "Pink Tickets" and Logbooks, 1950-1961.
Number of Albacore in 1950-1953 Calculated from Length Frequencies

Season	Catch		Number of albacore vessels	Days fishing	Catch per day		Average weight per fish
	Numbers	Pounds			Numbers	Pounds	
1950	4,546,167	61,748,870	3,161	62,592	73	987	14
1951	2,008,985	30,876,083	2,112	35,237	57	876	15
1952	3,247,559	49,803,524	2,149	46,544	70	1,070	15
1953	2,345,624	33,835,905	1,835	33,842	69	1,000	14
1954	1,975,591	26,106,962	1,605	39,678	50	658	13
1955	2,701,775	29,386,492	1,081	36,697	74	801	11
1956	2,575,111	37,168,560	1,290	37,890	68	981	14
1957	2,629,870	43,032,292	1,231	37,924	69	1,135	16
1958	1,702,551	27,179,250	1,080	24,767	69	1,097	16
1959	2,558,640	32,732,451	933	19,315	132	1,695	13
1960	2,450,474	34,896,894	882	20,208	121	1,727	14
1961	1,533,896	27,163,179	981	22,006	70	1,234	18
Mean	2,523,020	36,160,872	1,524	34,725	73	1,041	14

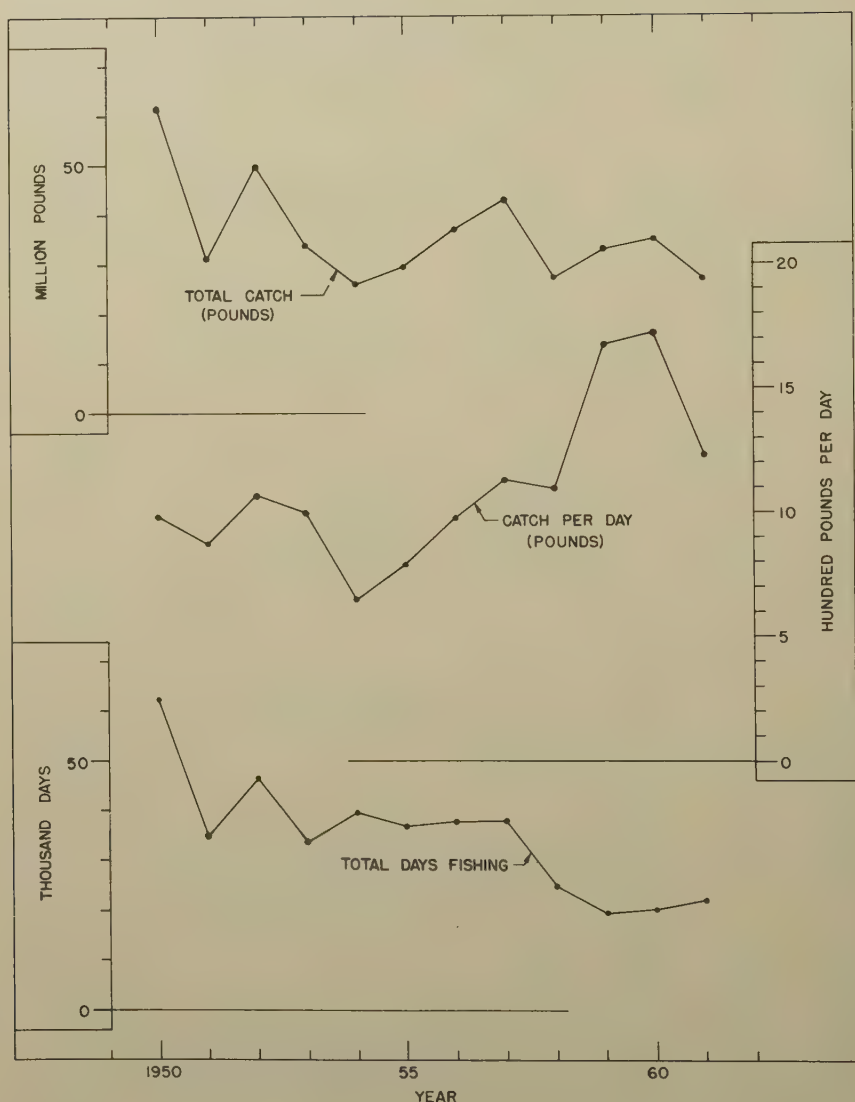


FIGURE 99. Statistics of the California commercial fishery, in pounds of albacore.

farther offshore compared to the one in 1952, it would have produced more heavily if additional effort had been expended. Final figures show the catch dropped to 2.3 million fish weighing 33.8 million pounds—a 16-million-pound decline from 1952.

During 1954, fishing intensity improved, reaching 40,000 days (110 boat-years) despite a loss of 230 vessels compared to the previous year. The increased intensity, however, was insufficient to keep production from dipping to only 2.0 million albacore weighing 26.1 million pounds. The migration took place well offshore and was the smallest on record, averaging only 50 fish per day. This is 23 per day below the 12-year (1950–1961) mean.

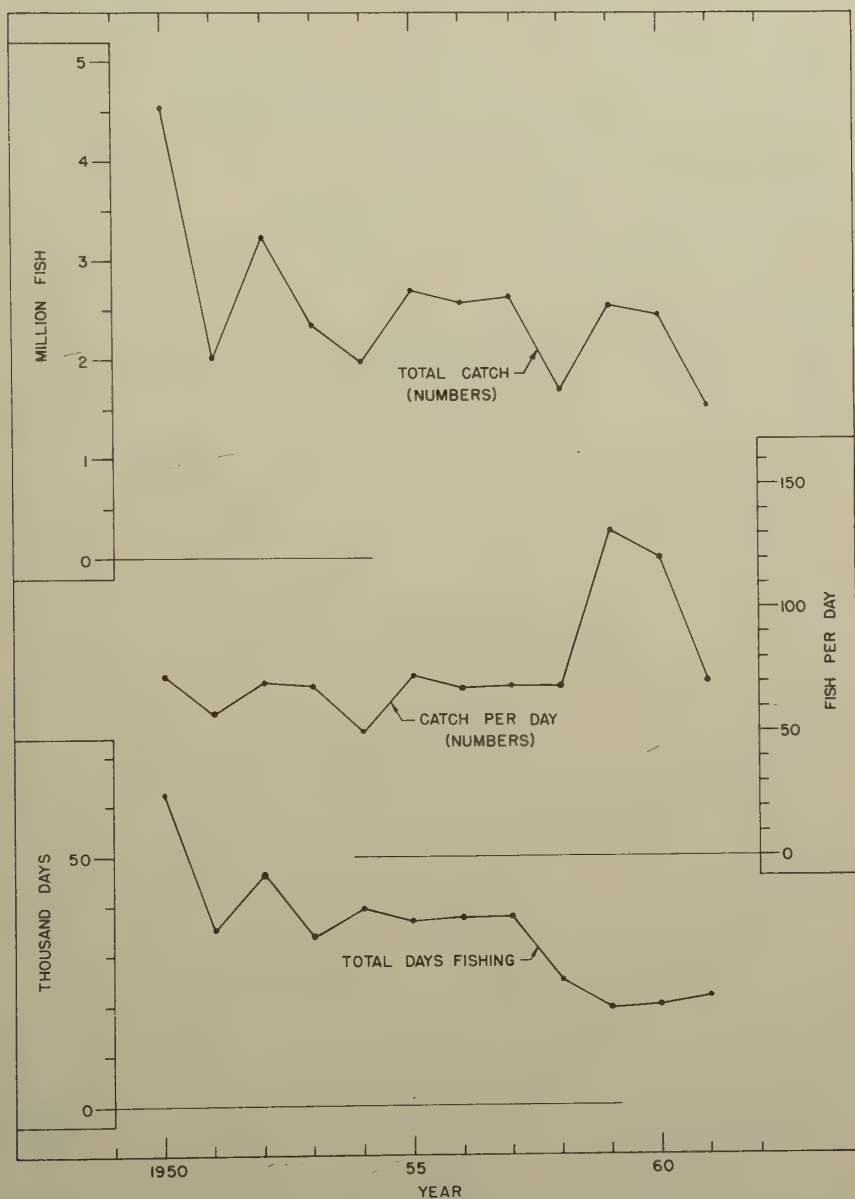


FIGURE 100. Statistics of the California commercial fishery, in numbers of albacore.

An average of 1,200 vessels operated during the 1955 through 1957 seasons; and total days spent fishing, numbers caught, and size of the runs remained comparatively steady (Figure 100). The pounds landed, however, increased each year; the harvest rose from 29.4 million pounds in 1955, to 37.2 million in 1956, and 43.0 million in 1957; at the same time, average albacore size increased from a record low of 11 pounds (62.0 cm) in 1955, to 14 pounds (67.5 cm) in 1956, and then to a high

of 16 (70.5 cm) in 1957 (Figures 15b, c and d; Table 6). The gain in average fish size in 1956 and 1957 accounted for the improved production in weight.

During the unusually warm 1958 season, only 1,030 vessels participated in the fishery, compared to a 1,231-vessel fleet in 1957. Intensity dropped sharply to only 25,000 days—a loss of 36 boat-years fishing. Although the run was fair-sized (69 fish per day), the decline in fishing intensity was sufficient to lower the catch to 1.7 million fish; the smallest number since 1954, and 2.8 million below 1950's record. Again, as in 1957, they averaged 16 pounds (2 pounds heavier than the 1950–1961 mean) but total poundage fell 37 percent, from the 43.0 million pounds landed in 1957 to only 27.2 million this year. The harvest would have been some 3 million pounds (12 percent) less if the fish had weighed in at their 14-pound average. The unusual speed at which albacore traveled through the fishing grounds and the northern, off-shore location of the run partly explain this decline in fishing intensity. Many skippers could not fish the rough seas off Point Arguello that year; and those that did, ran short of fuel attempting to keep up with the fast-traveling schools.

During 1959, a year of abnormally high sea temperatures, the fleet caught a spectacular 132 albacore per day, indicating an exceptionally large run (Table 6). Adverse weather and the prospect of long trips depressed fishing intensity to an all-time low—19,000 days. However, the total harvest of 2.6 million fish, weighing 32.7 million pounds, was a considerable improvement over the previous season despite 97 fewer vessels, 15 boat-years less fishing time, smaller fish, poor weather, and a migration that took place even farther north and offshore than in 1958.

The ocean cooled in 1960, and the migration occurred farther south and closer inshore than during the preceding warm-water years. It was another exceptionally large run, as indicated by an average catch of 121 fish per day. The fleet was the smallest in 20 years (only 882 vessels), and fishing intensity gained slightly (893 days) over the last year's record low, reaching 20,000 days. The catch, however, totalled 2.5 million albacore weighing 34.9 million pounds and would have been even higher, but the fleet was held in port during a price dispute in early July—the prime fishing month of this season.

During 1961, the sea continued to cool, and the fleet was augmented by 99 vessels, enlarging it to 981; fishing intensity increased by 1,798 days (5 boat-years) to a 22,000-day total, and the migration, which was farther south than that of the cool 1960 season, returned to nearly average size (70 fish per day). Although there was a large rise in intensity, only 27.2 million pounds (1.5 million fish) were landed—nearly 8 million pounds or almost 1 million albacore below the 1960 catch. Fortunately the fish were exceptionally large (averaging a record 18 pounds), or the decline would have exceeded 13 million pounds. A large decrease in numbers of small albacore (13-pounders) in the run, and an increase in the amount of larger ones resulted in the heavier-than-average weight.

Discussion

Catch-per-effort statistics derived from pink tickets were compared with those from log books for the years 1951 through 1961 (Figure 101). Since annual fluctuations and the general trend were similar, we utilized catch-per-boat-month from the tickets to discuss the fishery, beginning in 1931. Comparing the catch-per-day in pounds and in numbers from logbooks, however, revealed substantial differences. These were attributed to changes in size composition of the run, as evidenced by length frequencies (Figures 14b through 16d) and variations in average fish weight (Figure 101; Table 6). This emphasized that both pounds and numbers are needed for a satisfactory catch analysis, and one based upon pounds alone should be used judiciously.

Examining the catch in numbers-per-day-fishing lead us to some additional conclusions about the migrations. For example, during 8 of the 12 years 1950 through 1961, they remained fairly consistent in size; relatively small ones (< 60 fish per day) occurred in 1951 and 1954 and exceptionally large ones (> 100 fish per day) in 1959 and 1960. The net result was a slight upward trend, implying that the runs were not decreasing in magnitude (Figure 100). Interestingly, the sea was cool in 1951 and 1954 (Figure 9); while in 1959 and 1960 it was abnormally warm and cooler than average, respectively. Small runs occurred only during the cool years.

Sea Temperature and Albacore Behavior

Clemens (1961b) has shown that California fishermen averaged 90 percent of their catch in ocean waters with surface temperatures ranging from 60° through 66°F (15.6° – 18.9°C)—areas where albacore also appeared to be most plentiful. Detailed measures of abundance and sea temperatures obtained from research cruises and fishermen's logs, over the past several seasons, confirmed this relationship. Abundance in numbers of fish for 5 years, 1957–1961, was calculated from the logs and summed by 3°F sea-temperature intervals (Figure 102). Included were data concerning more than 1.6 million albacore.

California's migrations in 1957, 1958, and 1961 were comparable in size (Table 6), and the schools distributed themselves similarly throughout the desired temperature regime each season, despite major changes in its geographic location. In warm 1957 and 1958, optimum conditions were situated differently than during cold-water 1961, and the schools reacted naturally by altering the direction in which they traveled. By estimating where "albacore water" would most likely occur each season, we have successfully predicted the general location of oncoming runs. As a rule, albacore were most plentiful in waters ranging from 62° through 67°F , which yielded 85 percent of the total reported during these 3 years (Table 7). Albacore abundance in temperatures cooler or warmer than these depended upon the number of very small (< 10 pounds, or 60 cm) and large (> 20 pounds, or 76 cm) fish participating in the migration. For example, small albacore, which abound in the surface layers, were not plentiful (Figures 15d, 16a and d), and consequently the coldest areas were unproductive (Figure 102). In contrast, large ones, which inhabit both the surface and deeper levels, were unusually abundant, and ocean areas having a warm surface temperature were fairly productive.

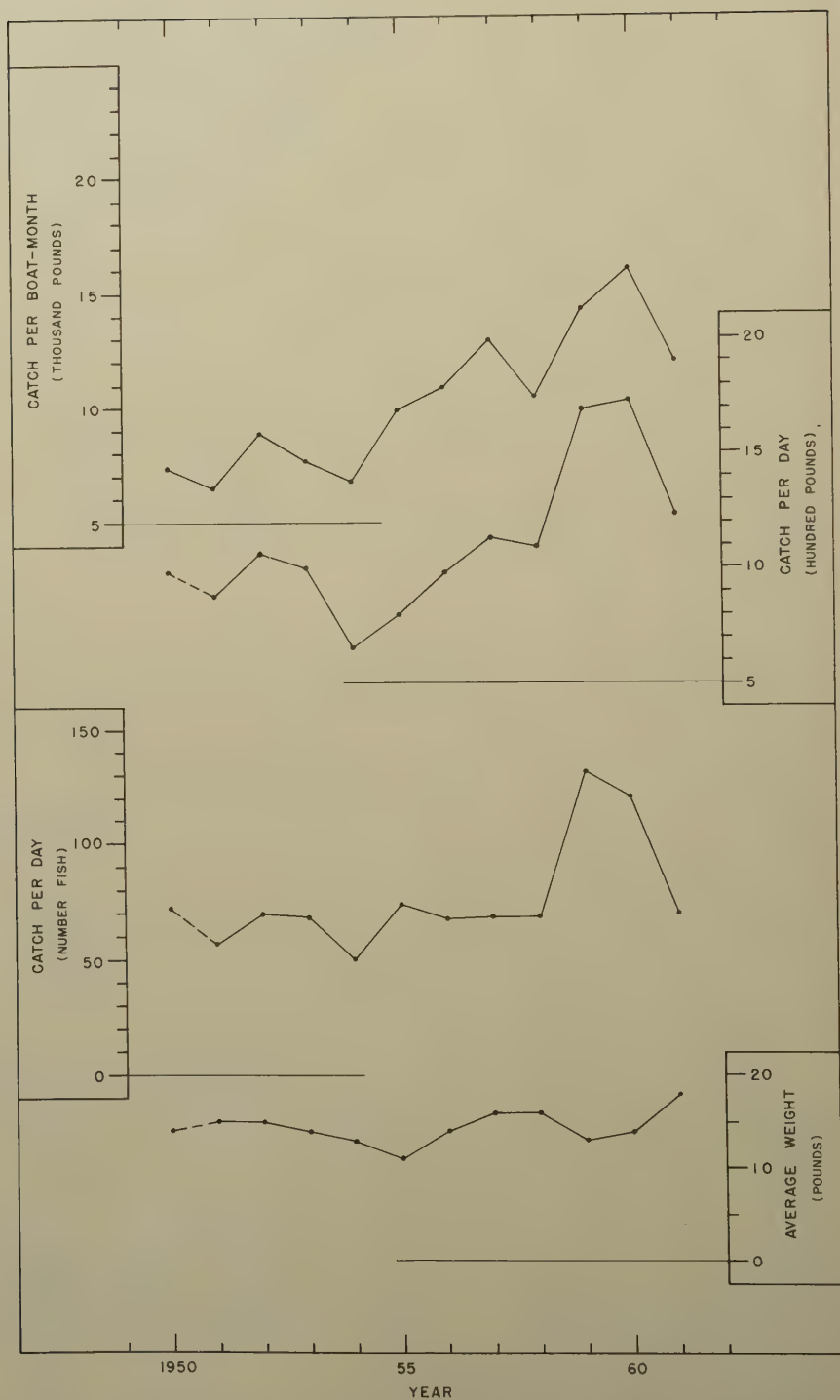


FIGURE 101. (Top) Catch-per-effort in pounds, from "pink tickets," compared to catch-effort from logs; (Center) Catch-effort in numbers of fish; (Bottom) Average albacore weight.

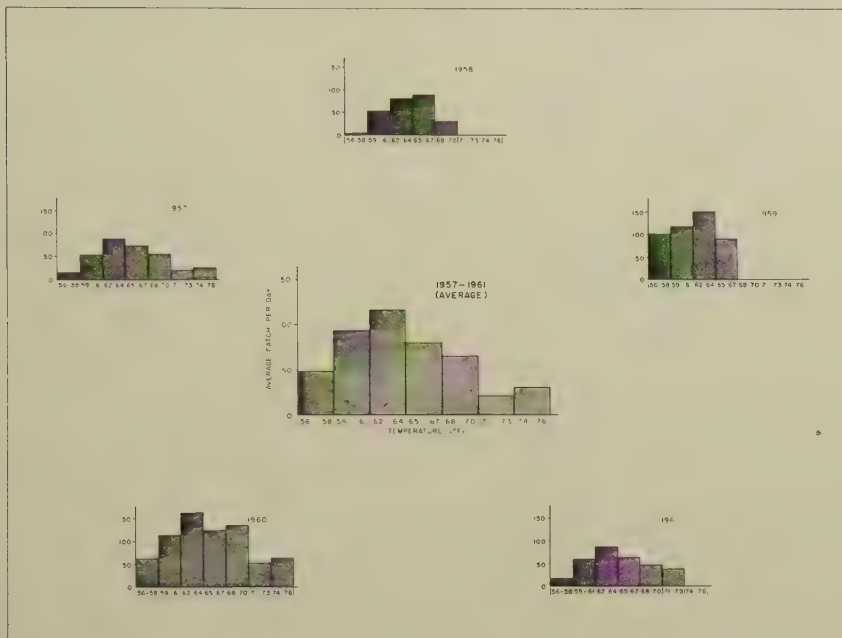


FIGURE 102. Albacore abundance (in numbers) by 3° F. sea-surface temperature intervals, 1957 through 1961, and the 5-year mean.

In 1959 and 1960, record numbers of albacore traversed the fishing grounds, and the runs were similar in size (Table 6). In warm-water 1959, only a relatively few large fish took part in the migration (Figure 16b), and no catches were reported from the warm temperatures (Figure 102); small fish appeared in fair numbers, however, and good fishing was found where the sea surface was cool. In cold-water 1960, many large albacore swam into the grounds (Figure 16c), and good fishing occurred in waters with a warmer surface temperature; few small fish took part in the migration, and catches declined in the cooler areas by comparison (Figure 102; Table 7).

We conclude that individuals participating in the albacore migrations distribute themselves within the desired ocean temperatures depending upon their size or age. If a migration consists predominantly of large fish (> 20 pounds), best fishing will be found in warmer (> 67°F) parts of the preferred temperature regime; and if it contains a lot of small ones, good fishing will occur in the cooler part, regardless of whether the season turns out to be a warm or cold one. Thus, each migration (as a unit) behaves according to its size or age composition, and fishing success in various sea surface temperatures depends upon both the composition of the run and its magnitude. Foreknowledge concerning the migration's size composition could provide valuable information about where, within the optimum temperatures, albacore might occur most abundantly.

To examine albacore—temperature relationships further, our abundance indices for 1959 through 1961 were compared with isotherms obtained from the U.S. Bureau of Commercial Fisheries Biological Laboratories at Honolulu in 1959 and San Diego in 1960 and 1961 (U.S. Bur.

TABLE 7
**Albacore Abundance in 3-Degree Intervals of Sea-Surface Temperature Obtained
 by the California Commercial Fleet, 1957-1961**

Season:	Sea Temperature °F.						
	56-58	59-61	62-64	65-67	68-70	71-73	74-76
1957							
Number of fish	338	13,743	154,262	160,270	35,939	1,271	188
Days fishing	20	249	1,709	2,128	636	62	7
Fish per day	17	55	90	75	57	20	27
1958							
Number of fish	79	10,676	140,736	66,501	1,541	0	0
Days fishing	16	200	1,732	747	49	0	0
Fish per day	5	53	81	89	31	0	0
1959							
Number of fish	3,758	109,452	326,779	2,911	0	0	0
Days fishing	37	927	2,163	32	5	0	0
Fish per day	102	118	151	91	0	0	0
1960							
Number of fish	6,444	114,876	232,110	39,435	22,620	53	65
Days fishing	103	992	1,399	310	165	1	1
Fish per day	63	116	166	127	137	53	65
1961							
Number of fish	1,236	48,366	106,159	41,743	6,802	157	0
Days fishing	65	803	1,212	653	143	4	0
Fish per day	19	60	88	64	48	39	0
1957-1961 (average)							
Number of fish	2,371	59,423	192,009	62,172	13,380	296	51
Days fishing	48	634	1,643	774	200	13	2
Fish per day	49	94	117	80	67	22	32

Comm. Fish.; 1959, 1960 a and b, and 1961). These were readily available, and although the measurements were in degrees fahrenheit, we chose to use them because it was convenient. First, the 58°F (14.4°C) isotherm for each month was selected as an approximate cold-water limit to the occurrence of albacore in quantity, and the one for 66°F (18.9°C) was charted to represent a warm limit. Next, the catch-per-day in numbers (relative abundance), by month, for each one-degree square was superimposed on the isotherms. In examining the results (Figures 103 through 121), it should be remembered that albacore schools do not occur uniformly throughout the thousands of square miles comprising each square; the catches are not distributed evenly within every month; and the isotherms represent gross monthly means. Despite these limitations, the data are useful for making general observations concerning abundance and the changes brought about by warm and cool sea conditions. Albacore appeared to be most plentiful on the fishing grounds from July through August, and they traveled upcoast each season as the warm isotherms advanced north and toward shore. Sea conditions, however, had no apparent effect on the season's duration. Also, albacore were abundant offshore during the warm 1959 season when larger numbers swam directly into the grounds above Monterey, and moved farther upcoast (Figures 104 and 105) compared to the cool year 1960, when warm water was farther south and larger numbers came in there (Figures 110 and 111). Most, however, inhabited the region between 58° and 66°F during all 3 years.

Using an index of abundance within small, comparable-sized areas and average sea surface temperatures, we have shown that the limiting configuration of certain isotherms and the rate they advanced stamped an imprint upon the albacore runs. Our abundance index is an excellent tool which can be used in the future for learning more about how albacore react to changing ocean temperatures and to other environmental factors, and how these actions affect the catch. When ecological relationships are fully understood, we will be in a much better position to predict behavior and thus, to improve the harvest.

THE SPORTFISHERY

History of Partyboat Fishing

Southern California's marine environment, including the offshore banks and islands, has been renowned as a paradise for fishermen since the days of sailing vessels. It was here, with a small sportfishing fraternity engaged in bluefin tuna angling, that albacore made their sporting debut.

California's bluefin became the most prized game fish during the 1890's, and Santa Catalina Island was a mecca for angling enthusiasts eager to try their skills against the great "leaping tuna," many of which exceeded 100 pounds. Landing one of these "home-guards," however, was not an easy task; they were extremely hook-wary, the fishing rods and lines were crude, and the small reels available at the time lacked good friction drags.

Kite fishing was developed for Santa Catalina Island waters in 1911 by "Tuna George" Farnsworth, and although boating skill, favorable breezes, a school of large tuna, and luck were required, it soon became

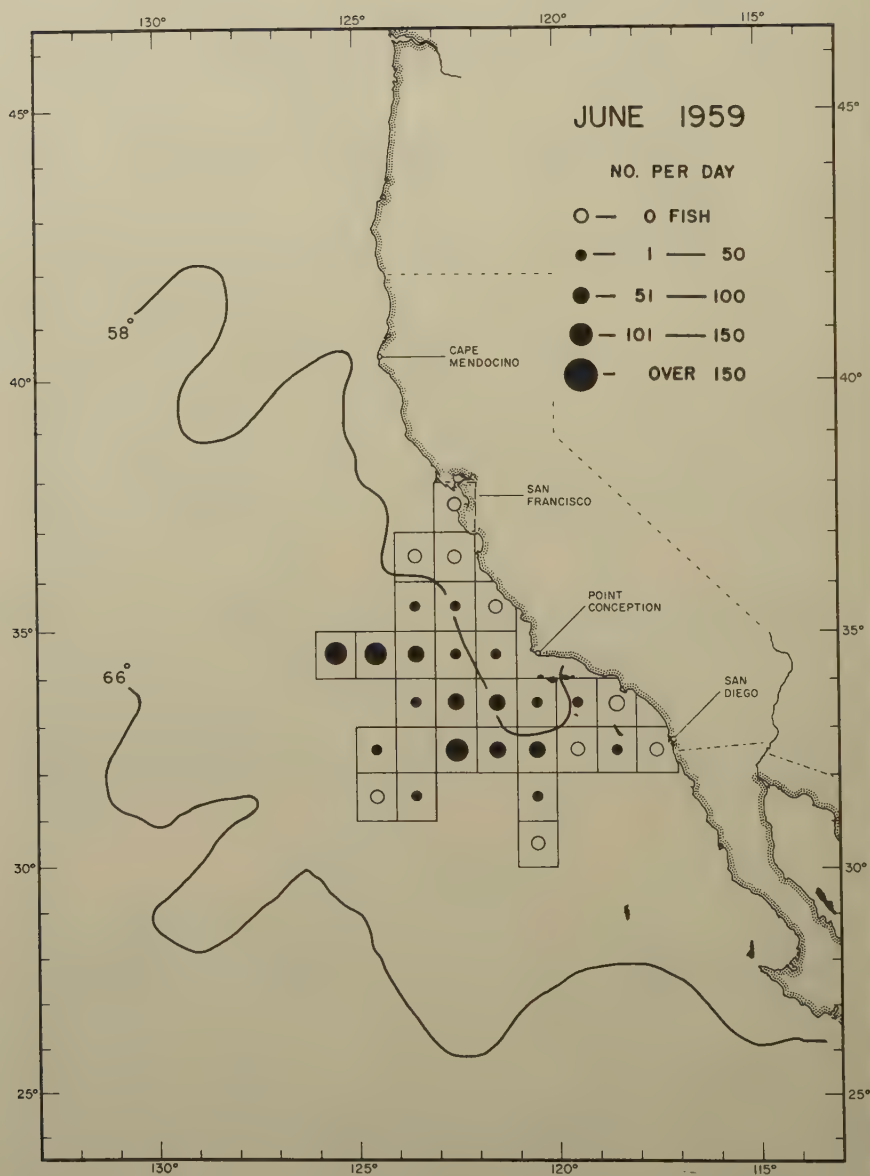


FIGURE 103. Albacore abundance by one-degree squares and selected sea-surface isotherms.

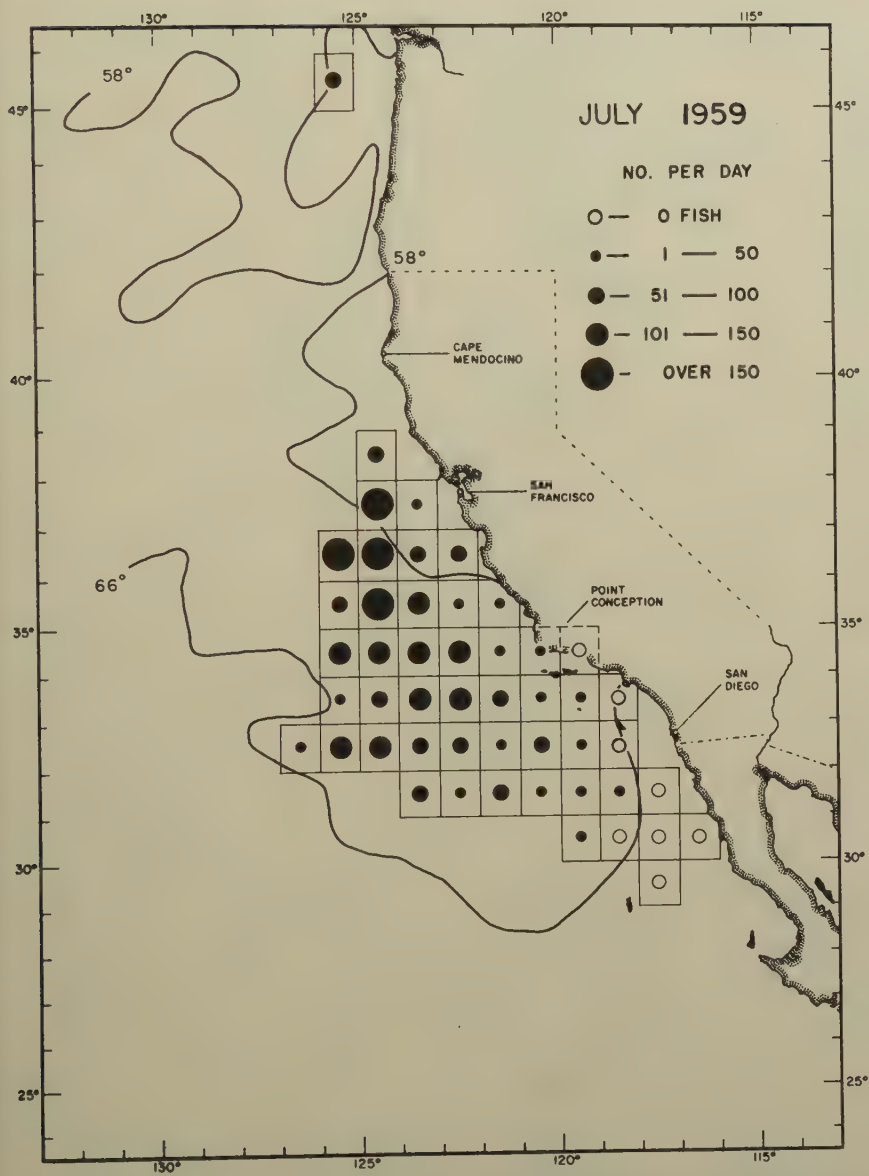


FIGURE 104. Albacore abundance by one-degree squares and selected sea-surface isotherms.

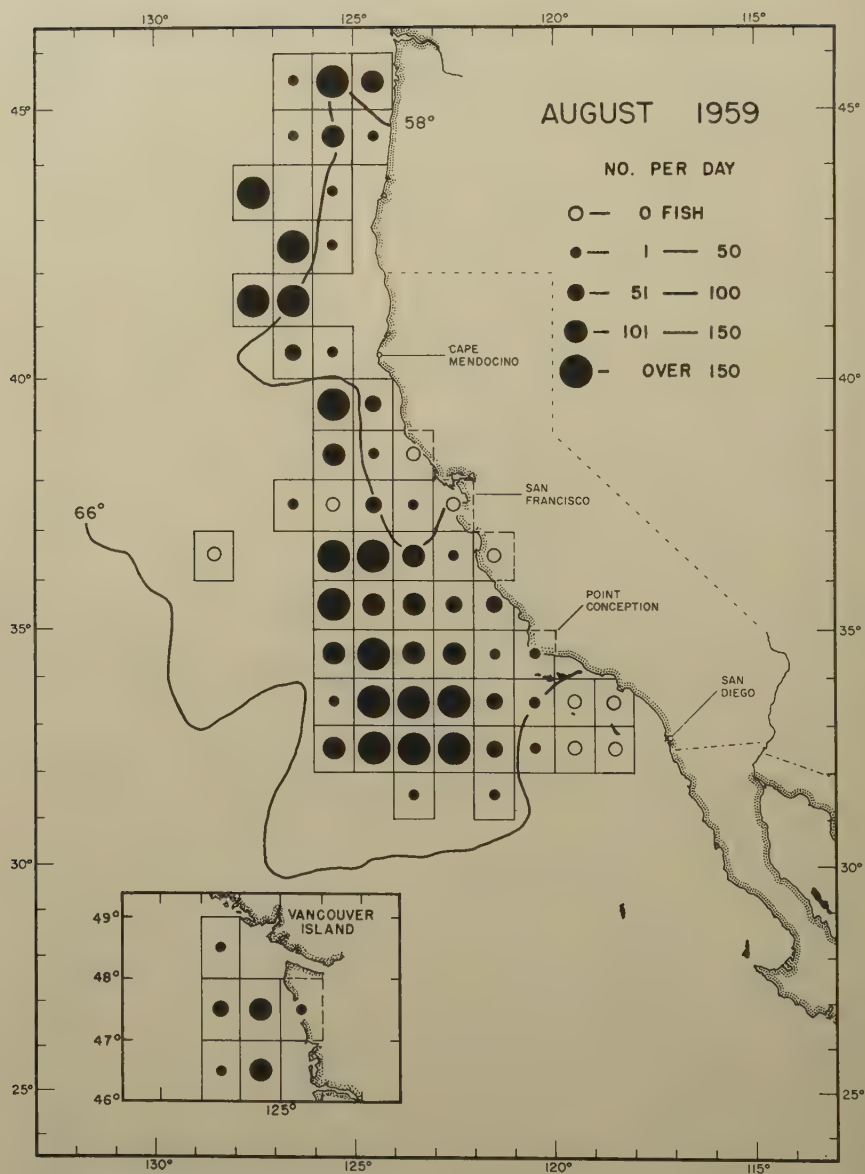


FIGURE 105. Albacore abundance by one-degree squares and selected sea-surface isotherms.

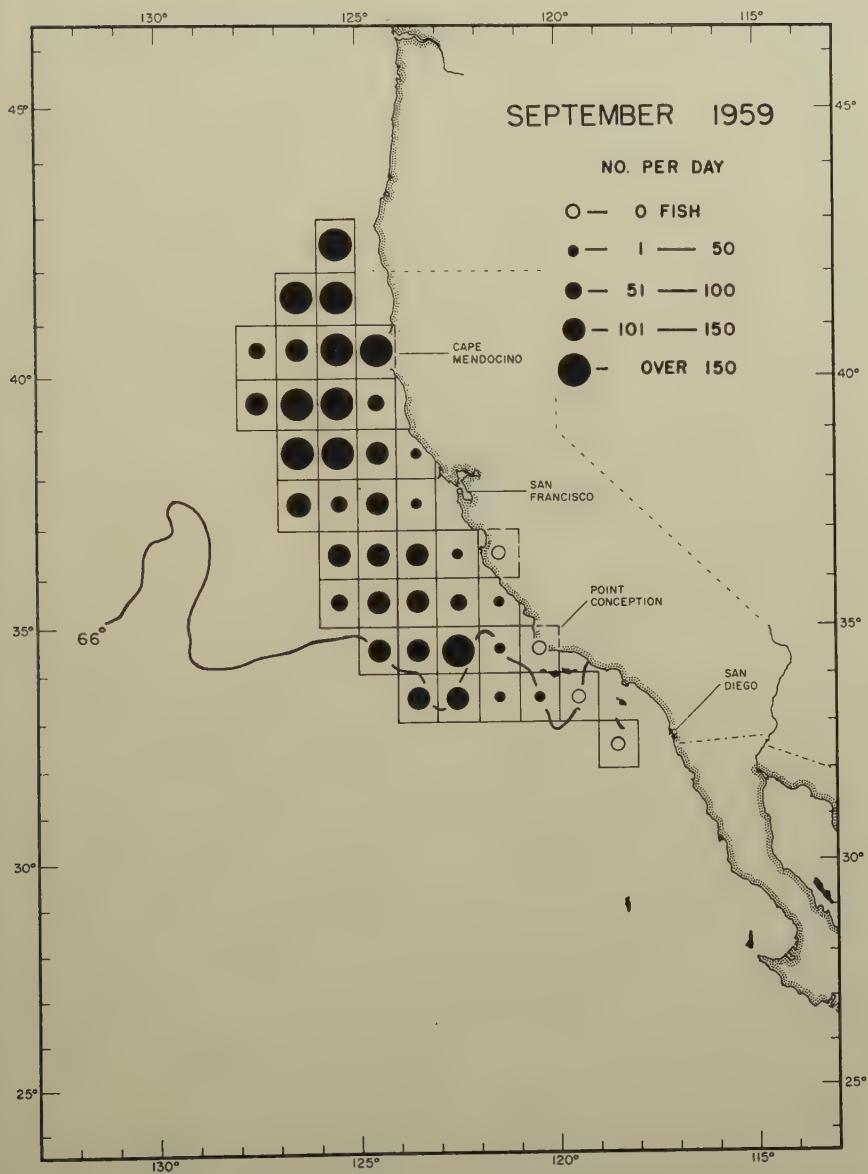


FIGURE 106. Albacore abundance by one-degree squares and selected sea-surface isotherms.

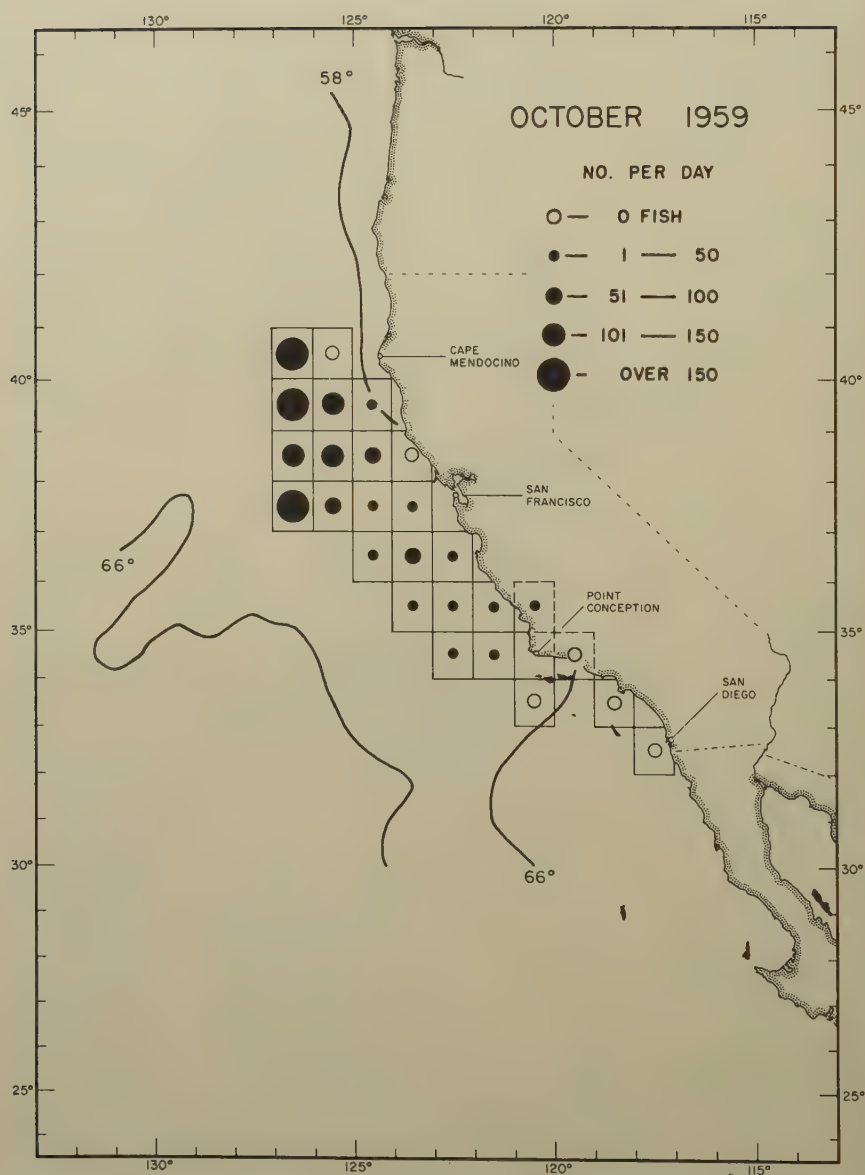


FIGURE 107. Albacore abundance by one-degree squares and selected sea-surface isotherms.

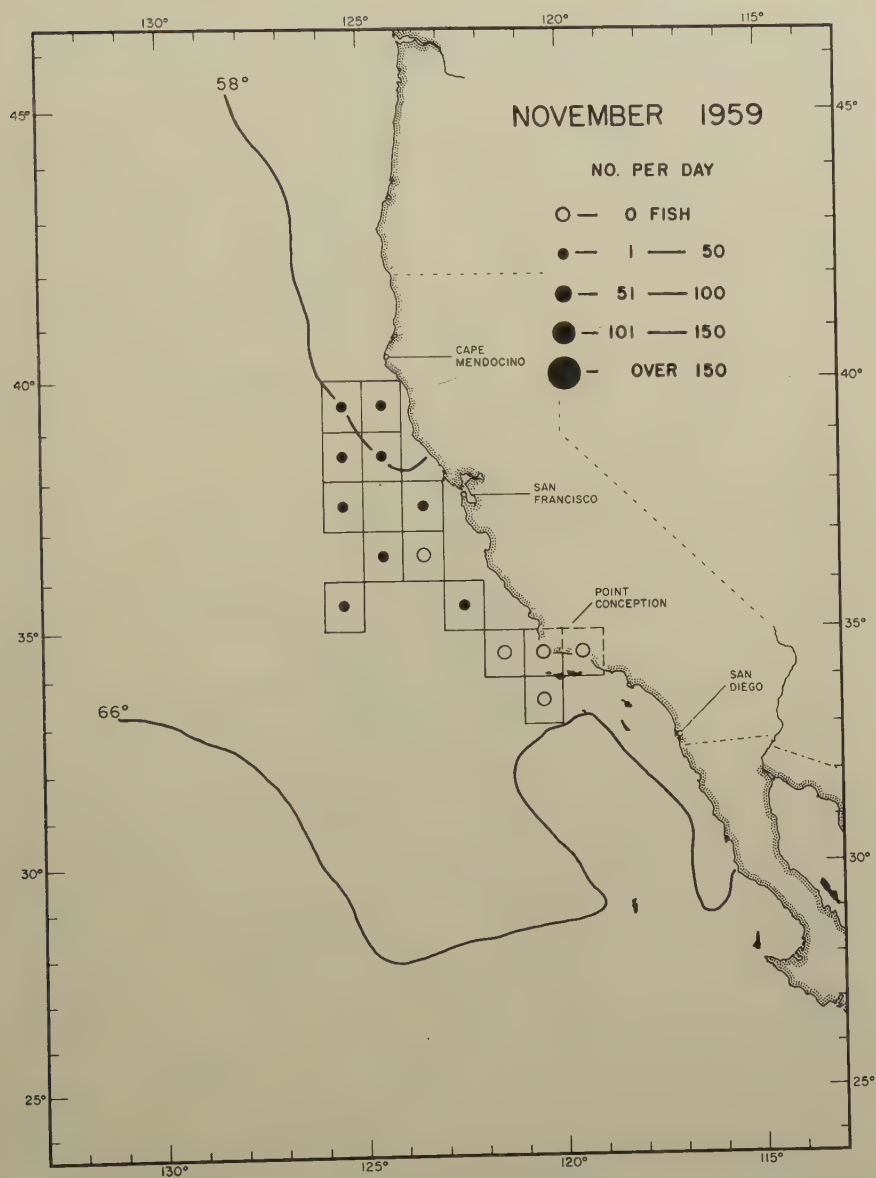


FIGURE 108. Albacore abundance by one-degree squares and selected sea-surface isotherms.

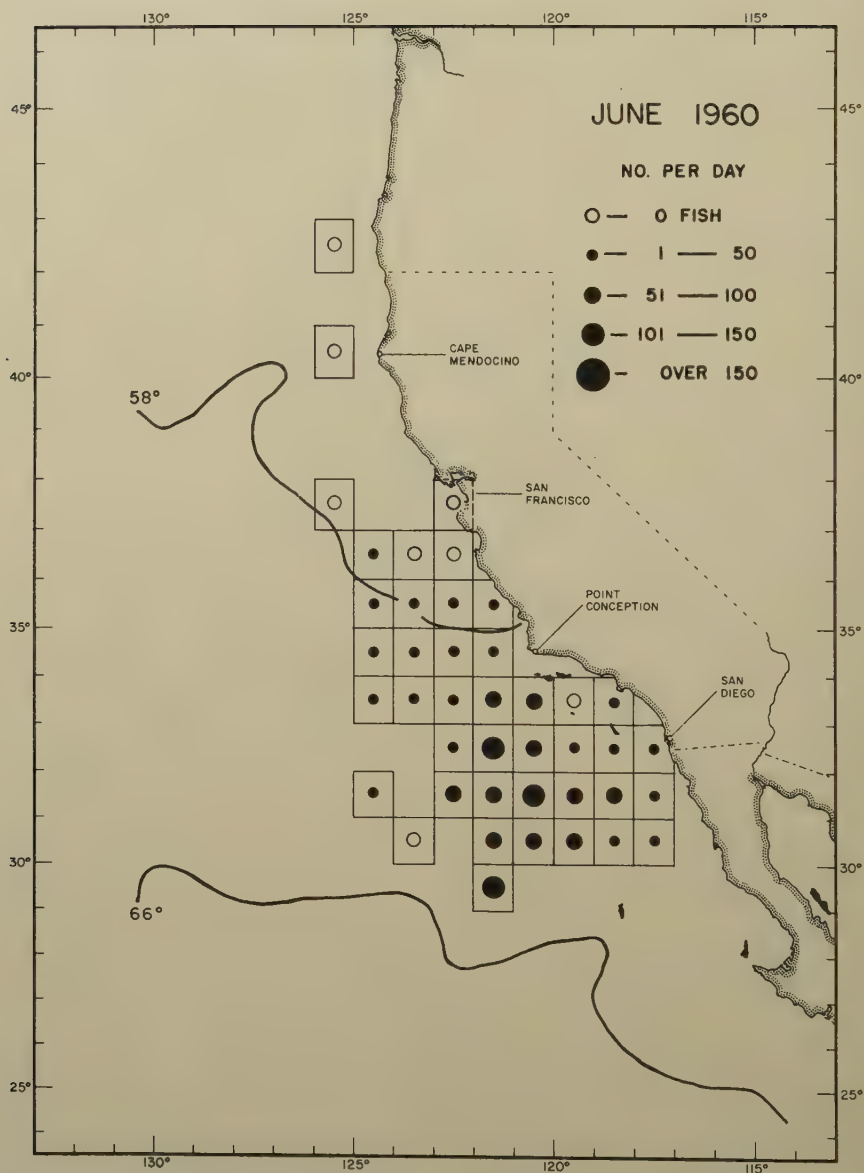


FIGURE 109. Albacore abundance by one-degree squares and selected sea-surface isotherms.

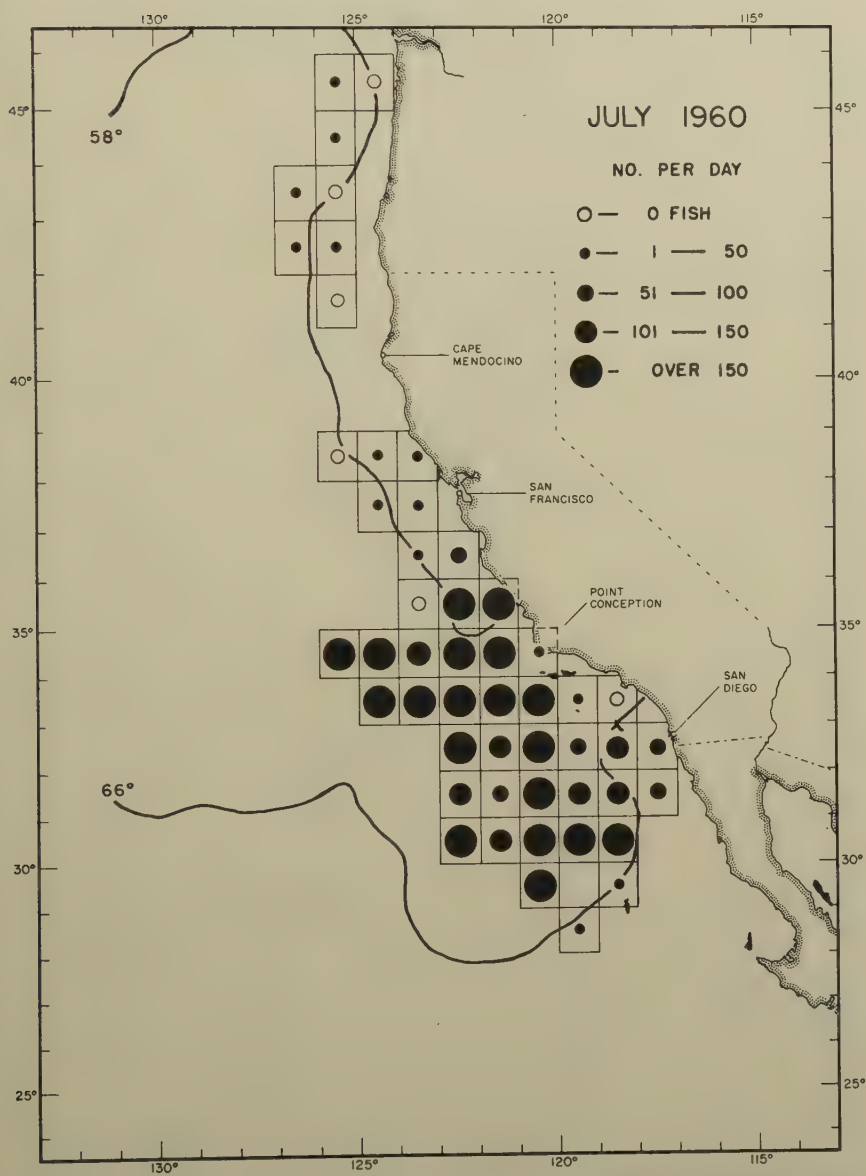


FIGURE 110. Albacore abundance by one-degree squares and selected sea-surface isotherms.

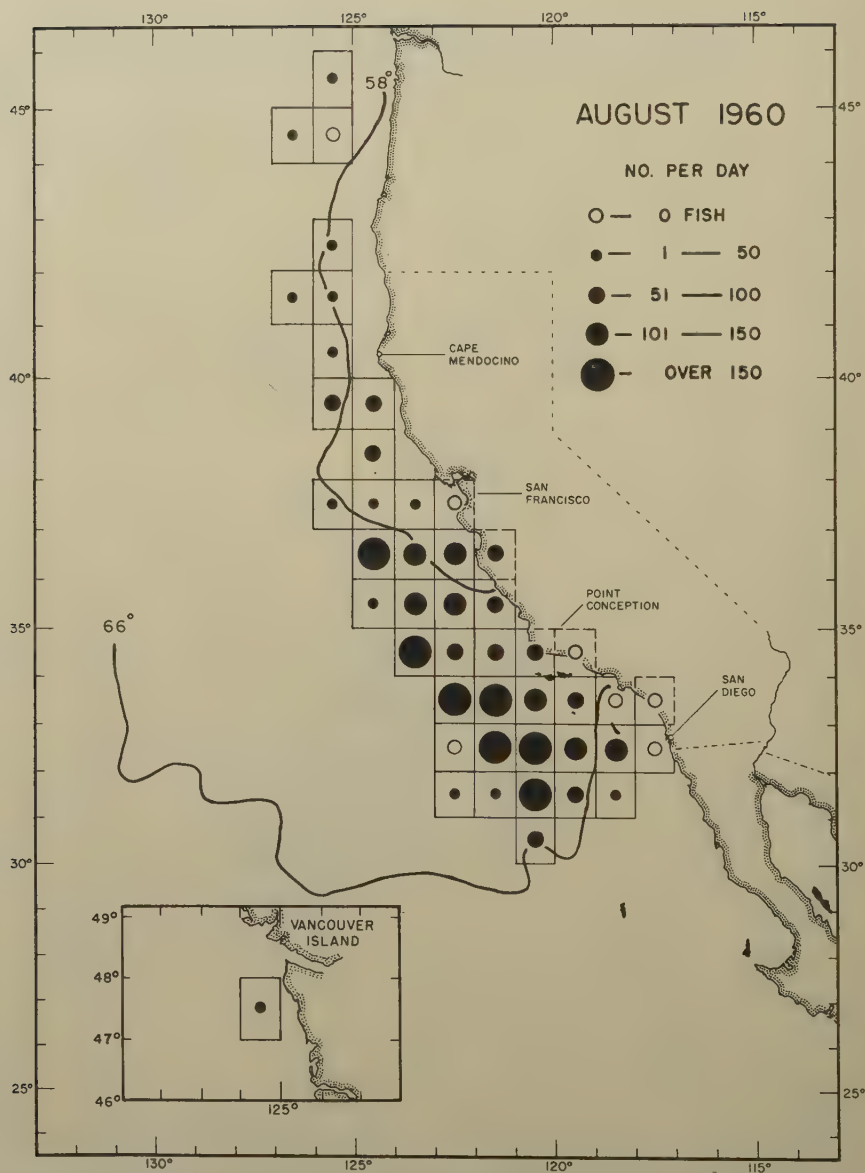


FIGURE 111. Albacore abundance by one-degree squares and selected sea-surface isotherms.

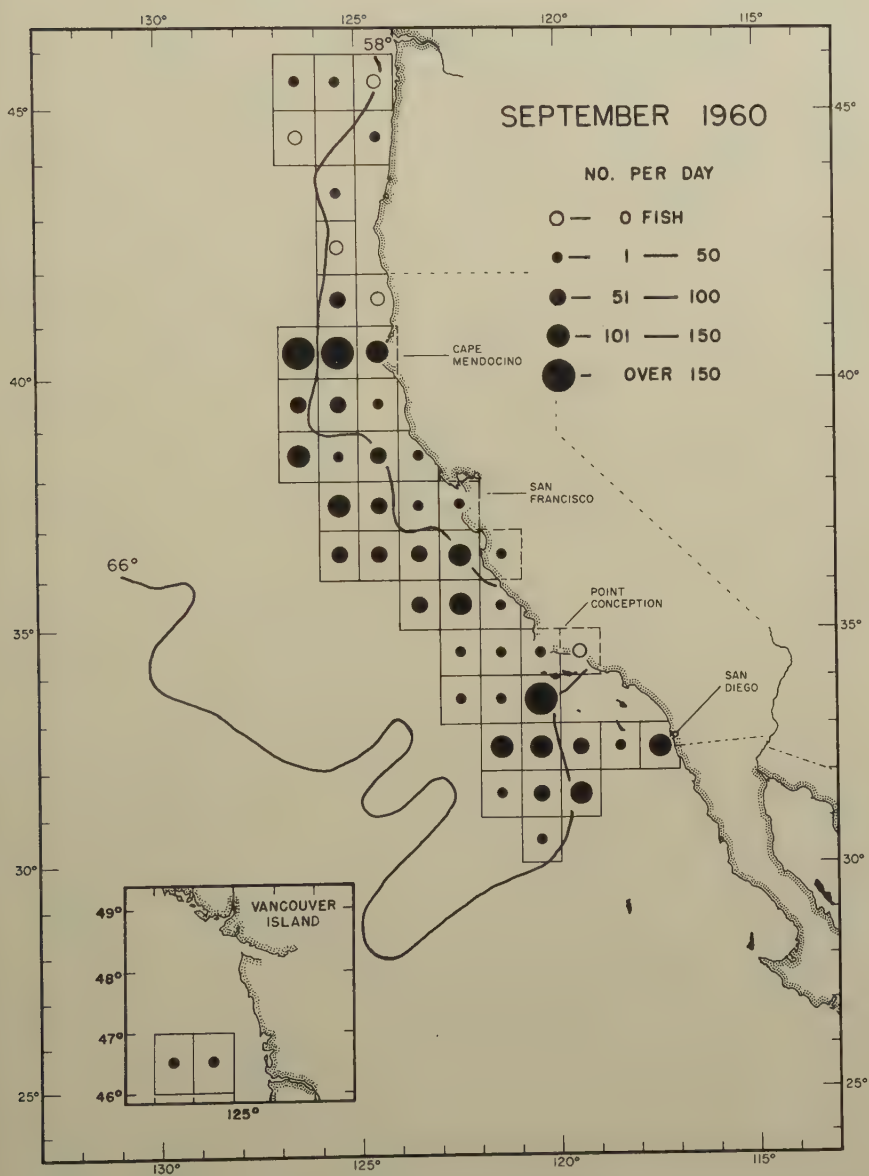


FIGURE 112. Albacore abundance by one-degree squares and selected sea-surface isotherms.

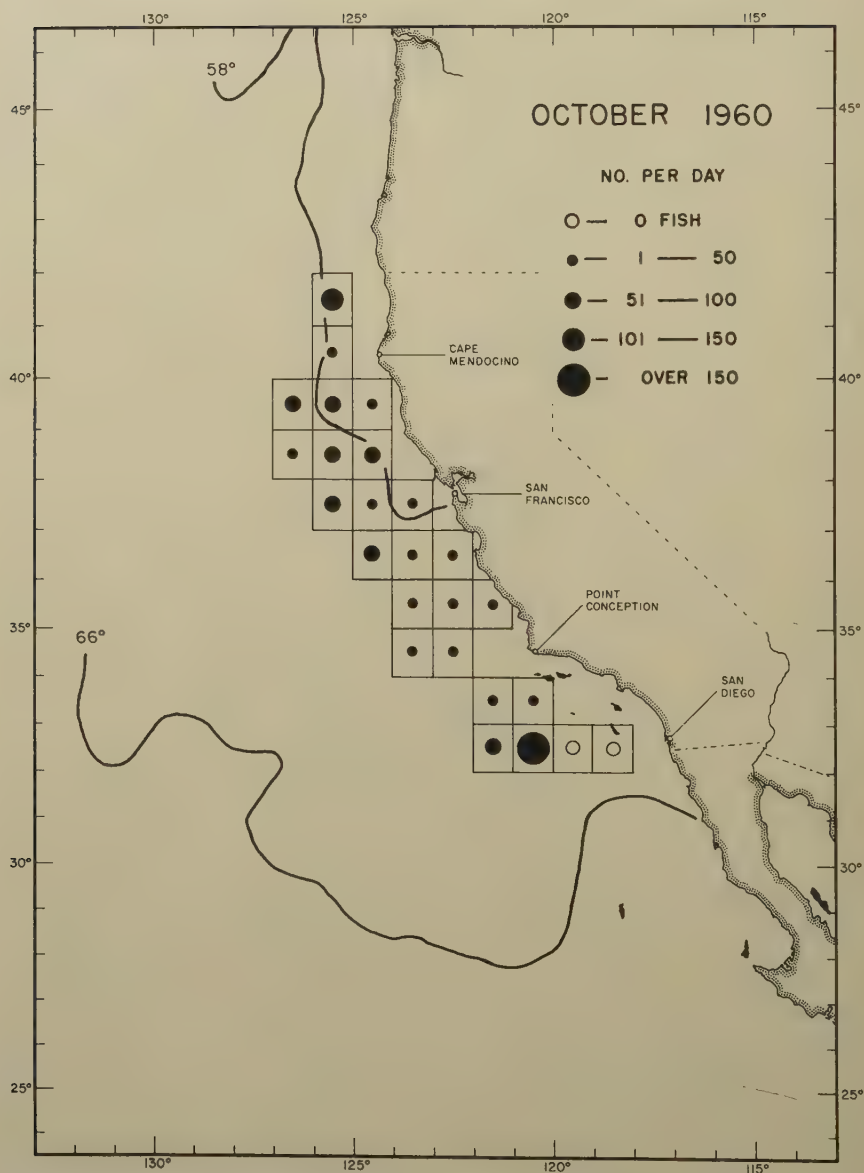


FIGURE 113. Albacore abundance by one-degree squares and selected sea-surface isotherms.

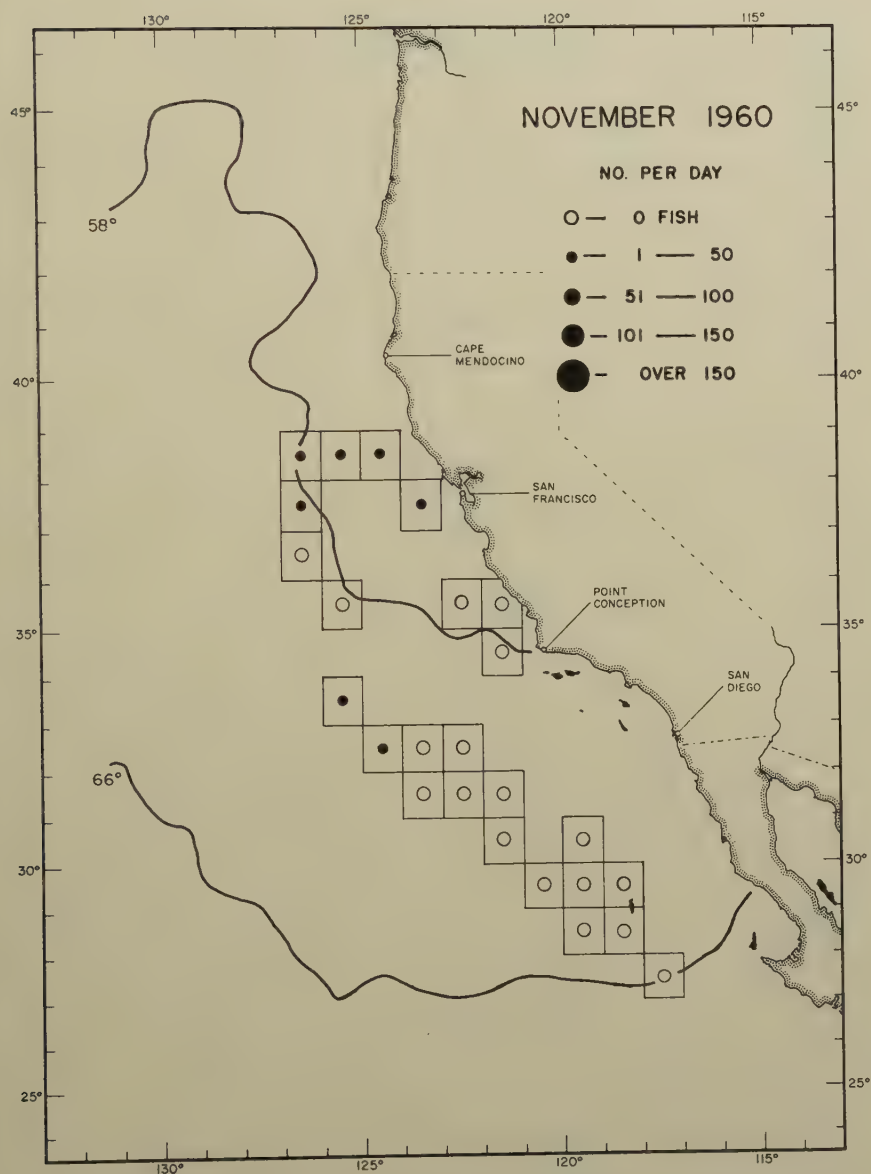


FIGURE 114. Albacore abundance by one-degree squares and selected sea-surface isotherms.

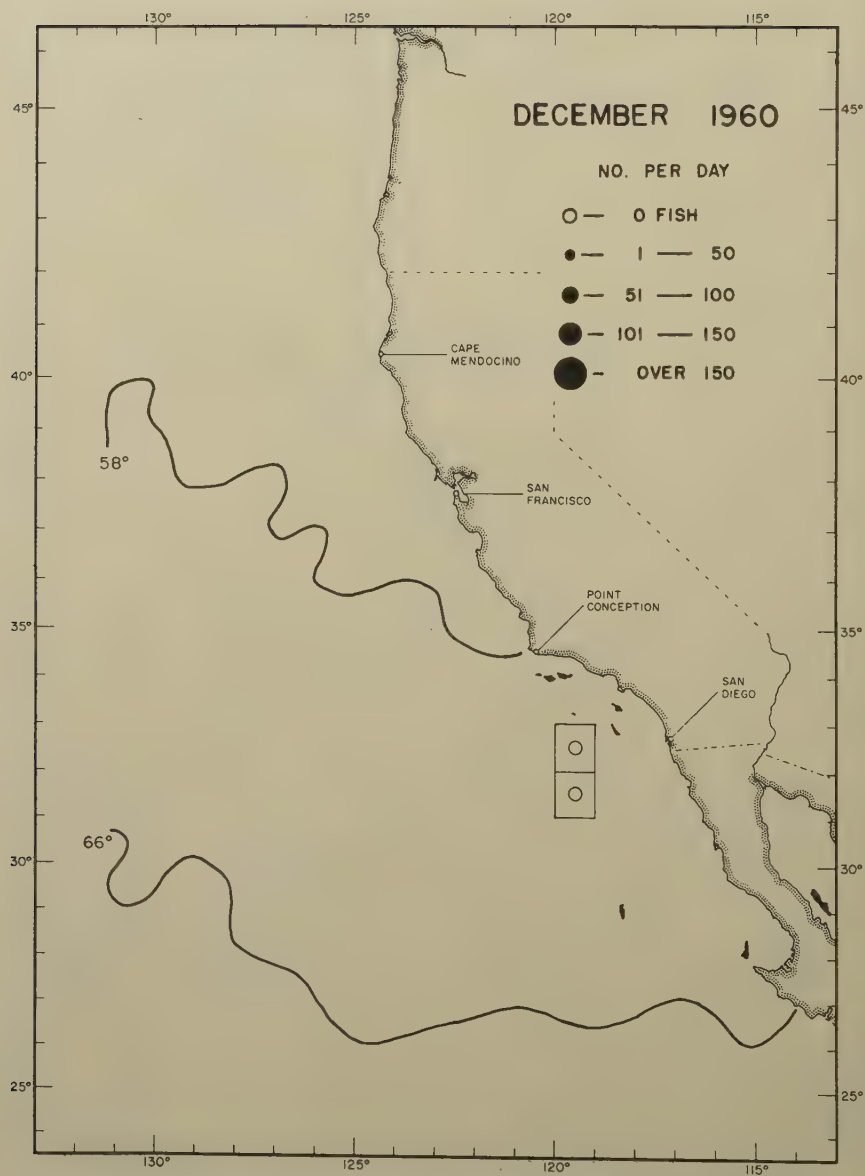


FIGURE 115. Albacore abundance by one-degree squares and selected sea-surface isotherms.

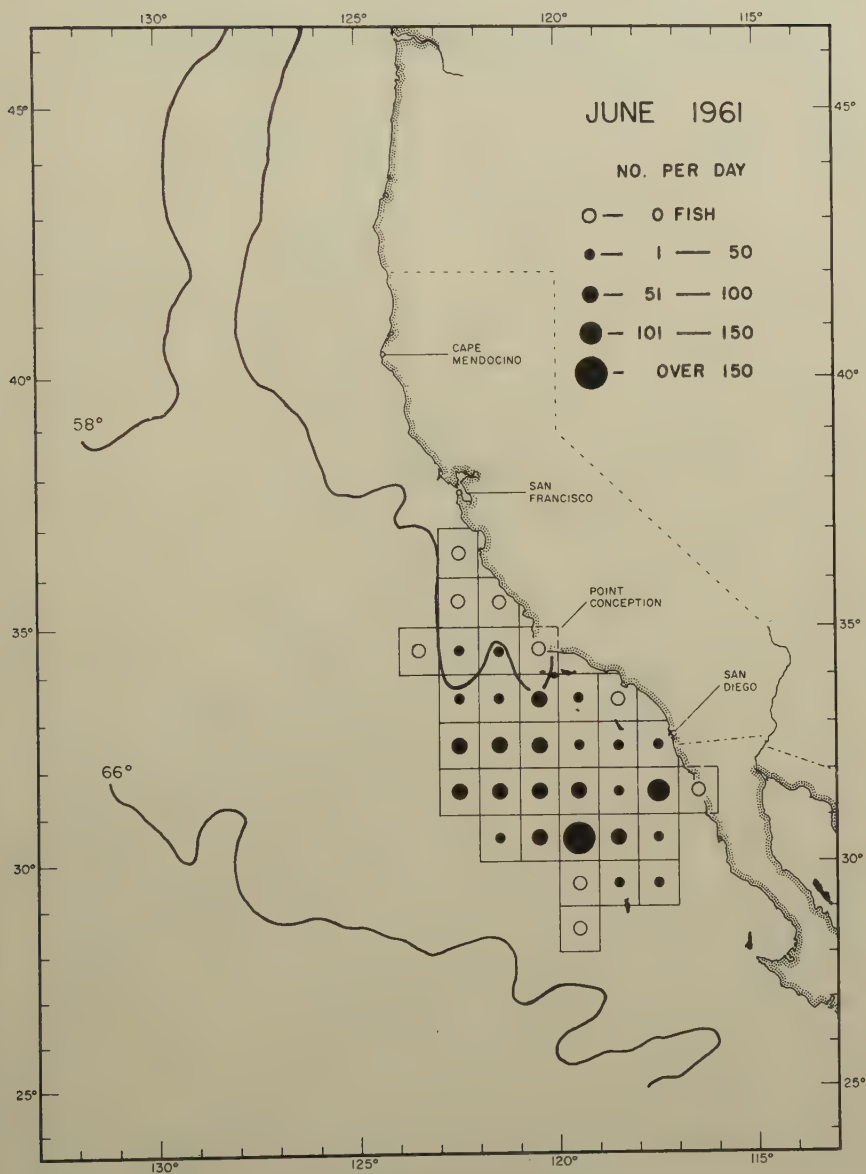


FIGURE 116. Albacore abundance by one-degree squares and selected sea-surface isotherms.

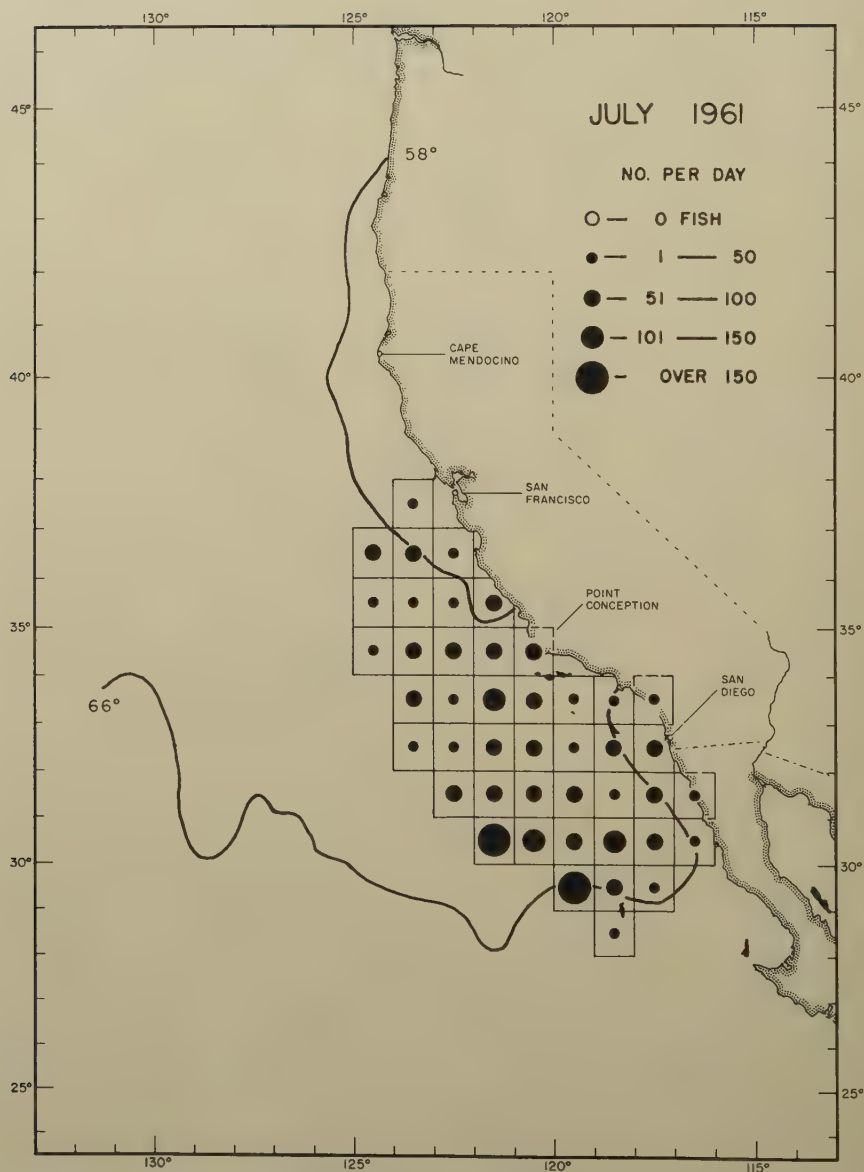


FIGURE 117. Albacore abundance by one-degree squares and selected sea-surface isotherms.

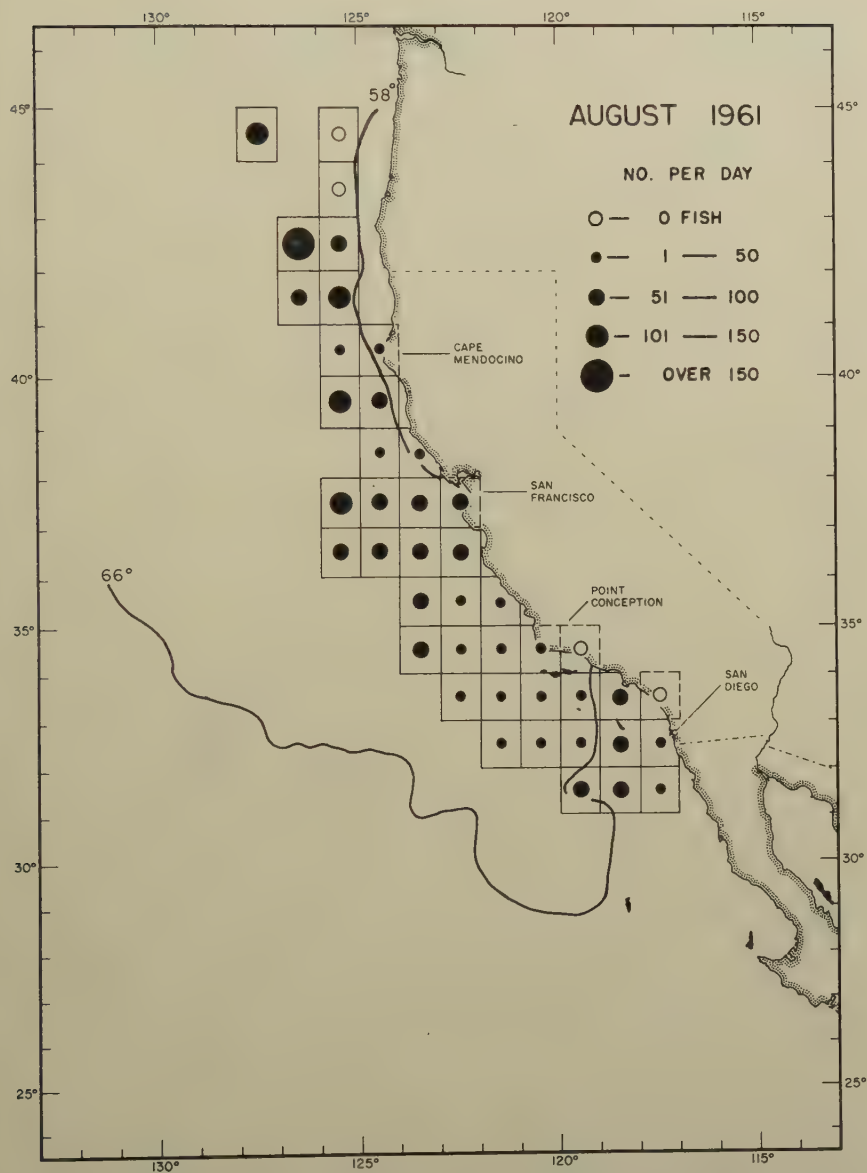


FIGURE 118. Albacore abundance by one-degree squares and selected sea-surface isotherms.

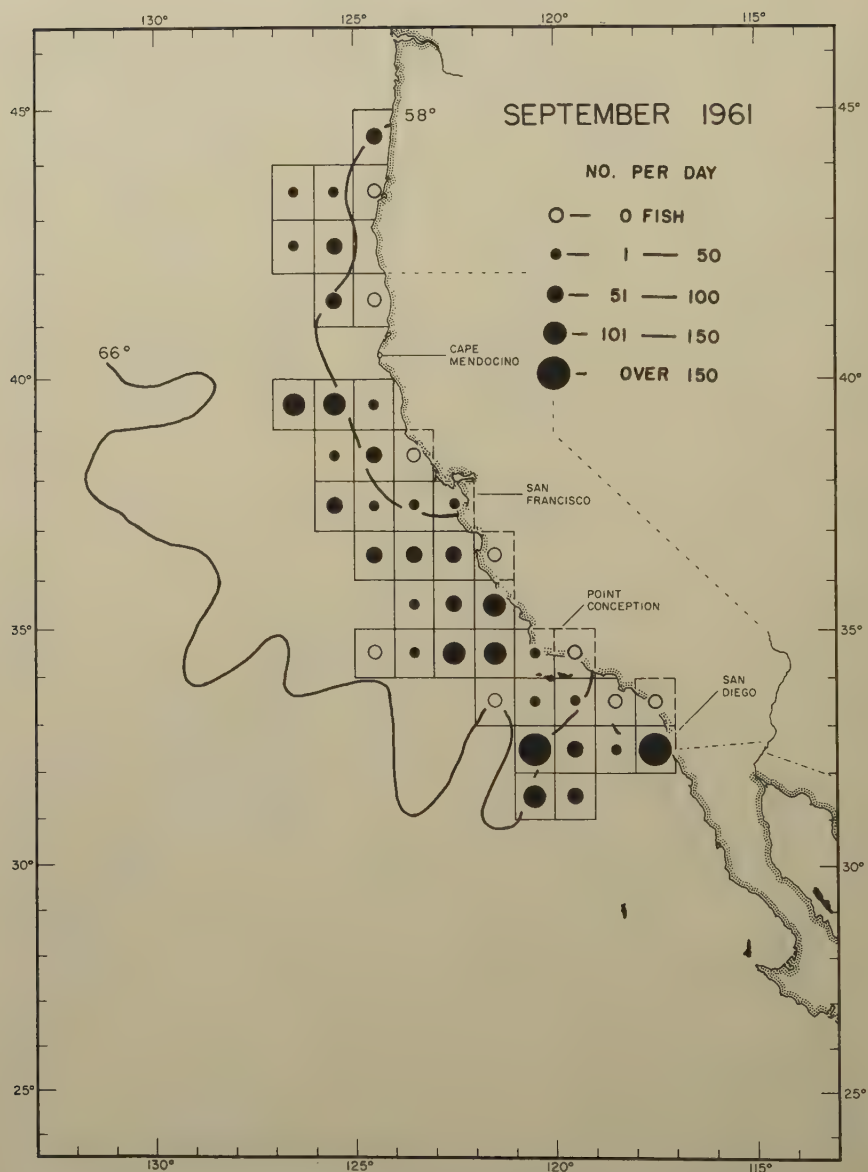


FIGURE 119. Albacore abundance by one-degree squares and selected sea-surface isotherms.

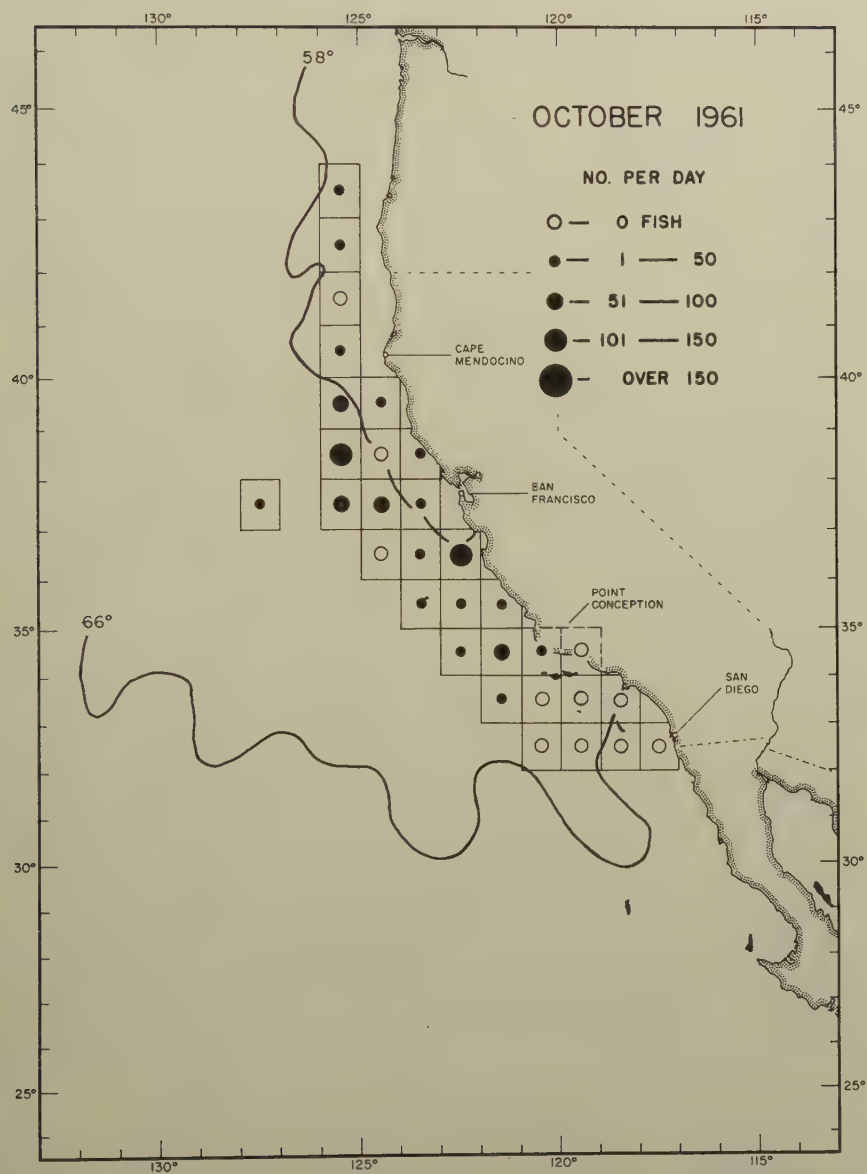


FIGURE 120. Albacore abundance by one-degree squares and selected sea-surface isotherms.

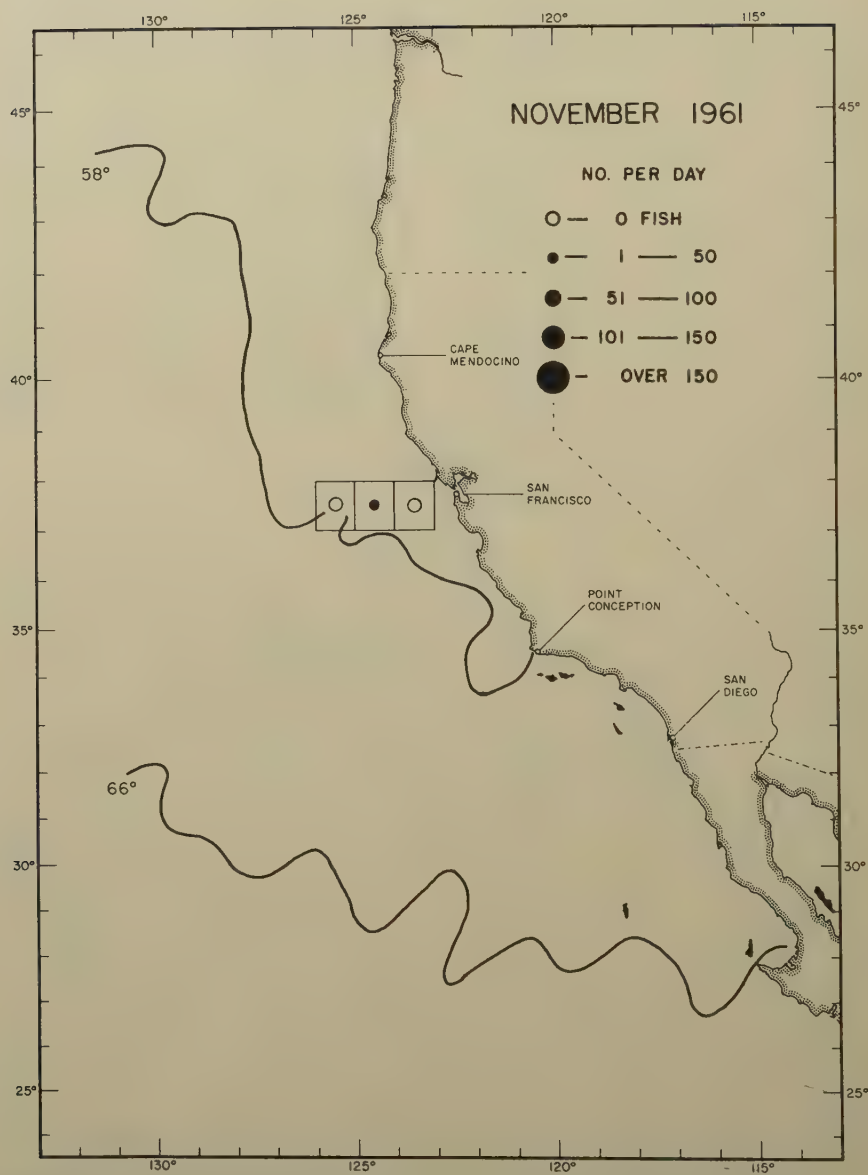


FIGURE 121. Albacore abundance by one-degree squares and selected sea-surface isotherms.

popular. Using this technique, an angler attached his fishline to a box kite and maneuvered it so the hook and its flyingfish bait skipped over the sea surface immediately in front of a school of the large bluefin—the kite was rigged to fall away when a fish struck (Thomas, 1930). The voracious albacore by comparison were faster, more numerous, and not a bit hook-shy. Many a bluefin angler painstakingly jockeyed his silken kite and its dangling bait near a school of “blue-button” 100-pounders, that may have taken several days to locate, only to be stunned by a sudden flash of a 15-pound albacore hitting his lure. Thus, albacore quickly earned a reputation as “bait stealers,” and when boated, each was hit on the head and unceremoniously dumped overboard. They were avoided whenever possible, and even pronounced unfit for human consumption—many were cut into 4- or 5-pound chunks and used as bait to catch giant seabass, *Stereolepis gigas*.

In its infancy, most deep-sea angling took place from private vessels. This was expensive, and active enthusiasts were limited to those with skill in seamanship and having access to large seaworthy vessels. Ocean fishing increased rapidly in popularity, and soon there was a great demand for deep-sea angling. As a result, a few enterprising captains began offering their experience and facilities for charter to take small, private parties out for a day's sport. This brought deep-sea angling within reach of additional enthusiasts and demand increased. Eventually the required fee was divided by the boat's passenger-carrying capacity, and tickets were sold to the general public. Thus, deep-sea angling became available to all, and the partyboat industry was born.

Shortly after the partyboat concept was introduced, over 100 vessels were plying the waters off southern California, and their multi-species catch had reached considerable proportions. In 1936, 173 partyboats sailed toward the open ocean carrying thousands of eager enthusiasts out for a day's excitement with rod and reel; deep-sea angling had entered the realm of big business.

On the average, during 5 seasons prior to World War II (1936–1940), more than 200 vessels operated statewide; of these, 59 fished albacore. Since the war, the partyboat fleet increased to a peak of 612 vessels in 1954 and then gradually declined to a new level. The number seeking albacore increased to a high of 304 boats in 1950 and averaged well over 200 during the post-war years 1947–1957 (Table 8). From 1958 through 1961, the season's total ranged between 382 and 402, while those cruising for albacore varied from 3 in 1959 to 149 in 1961. In recent years, most partyboats were large, especially built and equipped to carry quantities of live bait and a selection of fishing gear, plus a galley with refreshments and even an individual berth for every passenger (Young, 1963).

The true sporting and table qualities of albacore were quickly revealed, and instead of being considered troublesome, they became renowned as fighting game fish and played a vital part in the development and well-being of our marine sportfishing industry. Today, anglers eagerly await the arrival of these prized gamesters, and the air becomes supercharged with excitement when the first cry of “albacore” rides in on the sea breezes and looses “albacore fever” upon the land. No marine sportfisherman or sportswriter has ever fully recovered from such an experience—none has even tried.

TABLE 8
Albacore Sportcatch from California Partyboats, 1936-1961

<i>Calendar year</i>	<i>Albacore</i>	<i>Anglers</i>	<i>Catch per angler</i>	<i>Albacore partyboats</i>	<i>Partyboats (statewide)</i>
1936 -----	453	1,134	0.399	28	173
1937 -----	1,346	1,964	0.685	42	194
1938 -----	3,833	9,208	0.416	86	223
1939 -----	8,816	15,966	0.552	119	248
1940 -----	142	469	0.303	20	246
* *					
1947 -----	11,445	15,332	0.746	145	343
1948 -----	15,414	27,949	0.552	179	430
1949 -----	22,692	32,055	0.708	170	464
1950 -----	118,087	119,471	0.988	304	596
1951 -----	75,924	79,889	0.950	284	561
1952 -----	187,267	132,441	1.414	295	592
1953 -----	23,363	38,946	0.600	282	599
1954 -----	20,098	28,330	0.709	201	612
1955 -----	78,688	66,283	1.187	205	532
1956 -----	65,814	88,911	0.740	247	514
1957 -----	41,540	41,522	1.000	161	432
1958 -----	6,482	5,374	1.206	40	382
1959 -----	39	20	1.950	3	396
1960 -----	76,075	23,375	3.255	77	402
1961 -----	184,891	76,271	2.424	149	384
Average -----	47,120	40,246	1.171	152	416

* No data collected during World War II.

Partyboat Record Analysis

In 1932, a study was initiated to determine the number of partyboats in the fleet, size of the catch, species composition, trends in production for the various fishing grounds, and the importance of sportfishing in relation to other forms of outdoor recreation (Clark and Croker, 1933). This initial work, which was based upon voluntary records from captains and fishing license applicants, pointed out the importance of the fishery to Californians and demonstrated a need for more accurate statistics. Accordingly, the State Legislature enacted a law in 1935 requiring all partyboat operators to maintain catch records on prescribed forms. During the years that followed, several hundred captains logged their daily catches and mailed the documents to the California State Fisheries Laboratory. These records were submitted monthly and included date, port, total anglers, catch locality, number and estimated weight of each species caught, vessel name, and registration number (Croker, 1937). Partyboat records were available for all subsequent years except during World War II when none was kept.

The Department of Fish and Game "block-origin system" divides our coastal waters into small areas encompassed by 10-minutes of latitude and longitude; each section is serially numbered and identified on a key chart (Calif. Dept. Fish and Game, 1952). Partyboat operators use the chart to designate locations where fish were caught each day, and it has proven adequate for the more sedentary species landed by sportfishermen. However, albacore range far and wide, causing partyboat captains to operate over an extended area. Consequently, the 10-

minute squares proved too small, so we doubled the latitude and longitude, increasing the area 4 times, and resummarized all albacore catches into the resultant 20-minute squares. These were more consistent with the extended nature of albacore partyboat trips, yet small enough to reveal differences in fishing success between areas. Each square was located by the latitude and longitude in its southeast corner and coded for processing by subscripting the proper number 0, 2, or 4 to the degrees and dropping the last zero from the minutes. Thus, the 20-minute area bounded by latitudes $33^{\circ} 20'$ to $33^{\circ} 40'$ N. and longitudes $118^{\circ} 00'$ to $118^{\circ} 20'$ W. was designated 33₂-118₀ (Figure 122).

Anglers may catch a dozen or more different kinds of fish during a day's outing, thus complicating the assignment of fishing effort to any one species. Albacore, however, most often occur farther offshore than the other gamefish, and the special effort required to catch them usually resulted in a relatively exclusive fishery. With this in mind, one day of fishing effort was assigned to each angler aboard every partyboat landing at least one albacore; those aboard vessels obviously seeking albacore, but unsuccessfully, also were assigned fishing effort. The relative number of albacore on the sportfishing grounds, as measured by catch-per-angler-day, was calculated from monthly catch and effort figures for each 20-minute square. For convenience in charting the data, all figures were rounded to one decimal place; some of the least productive squares thus received 0.0, even though there was some fishing success (Figures 122-174).

The records reveal that albacore sportfishing was limited to only a small portion of the southern California Channel Islands area during pre-war years 1936-1940 (Figures 122-133). Relatively few fish ran within reach of the partyboat fleet, and as a result, passengers on less than 27 percent of the vessels operating statewide reeled-in albacore (Table 8). The comparatively few anglers were only fairly successful, averaging 0.5 fish per angler-day.

In the 3 years immediately following World War II (1947-1949), angling was more widespread (Figures 134-142) as somewhat larger numbers of fish entered the grounds. Nearly 40 percent of the increasing fleet caught albacore, and a comparatively larger number of anglers enjoyed improved success, averaging 0.7 fish per day.

During 1950 through 1957, the sportfishing grounds encompassed nearly the entire Channel Islands area (Figures 142-167), and the partyboat fishery experienced some excellent albacore runs. About 45 percent of the record-sized fleet came into port with albacore, and angling success reached an average 1.0 fish per angler-day.

In 1958 and 1959, few fish entered the sporting grounds, and the catch was exceptionally low (Figures 167-170). Only 40 of the 382 partyboats operating statewide landed albacore in 1958, and just 3 out of 396 boats succeeded in 1959. The anglers during these 2 years, however, were very lucky, for they enjoyed a small flurry of "hot" fishing and averaged better than 1 fish per day.

During 1960 and 1961 seasons, exceptional numbers of albacore migrated through the sportfishing area; the total vessels and number of anglers increased markedly, as did their success (Table 8). An average of nearly 50,000 anglers landed 2.6 fish per day in the expanded fishing grounds (Figures 170-174).

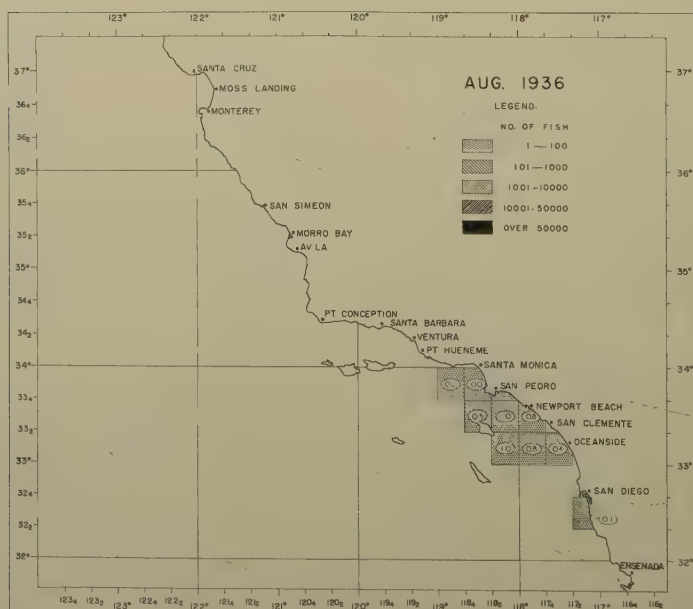
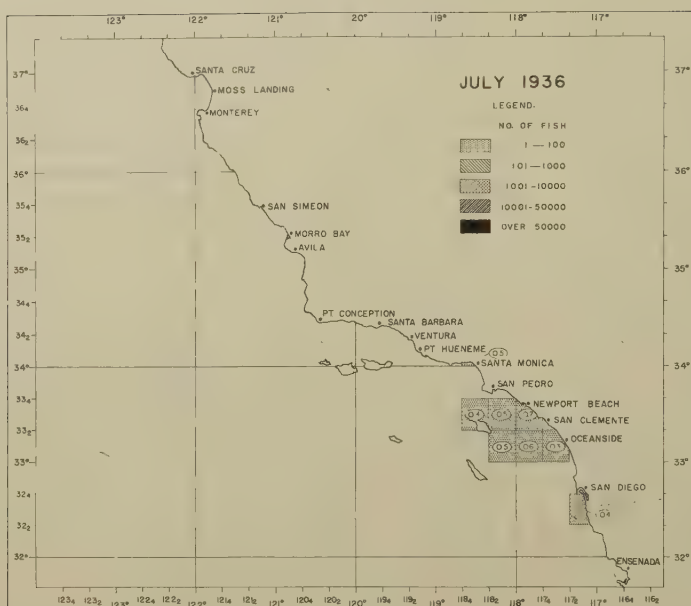


FIGURE 122. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

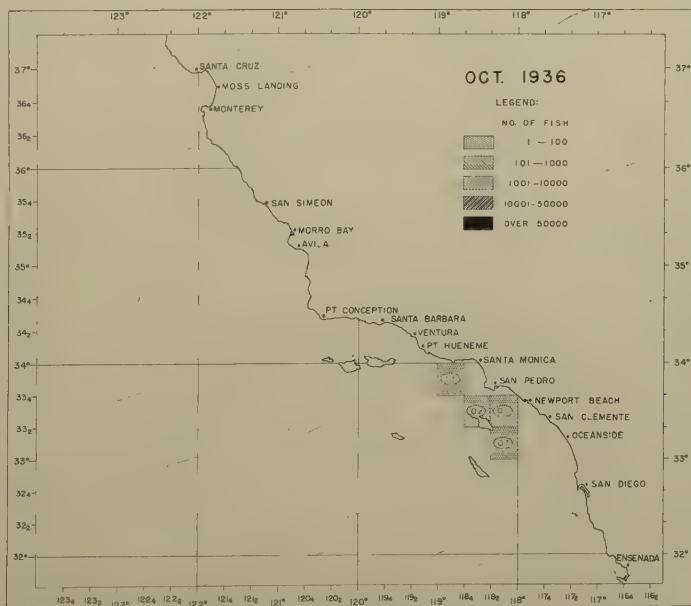
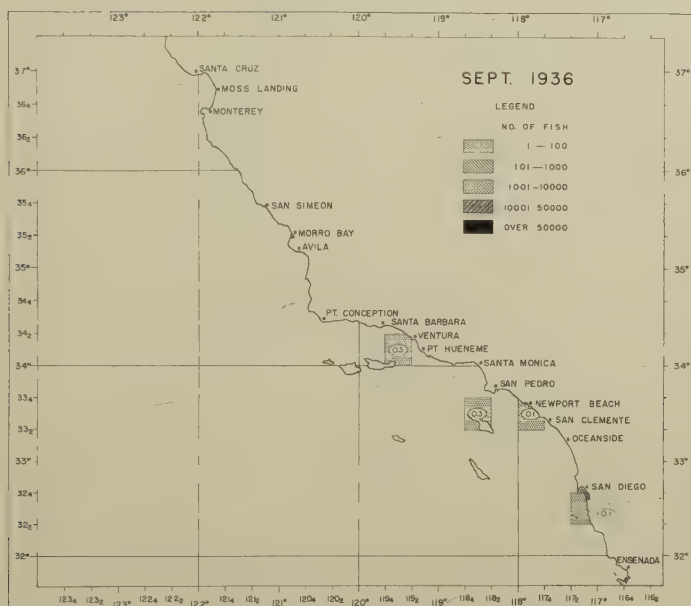


FIGURE 123. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

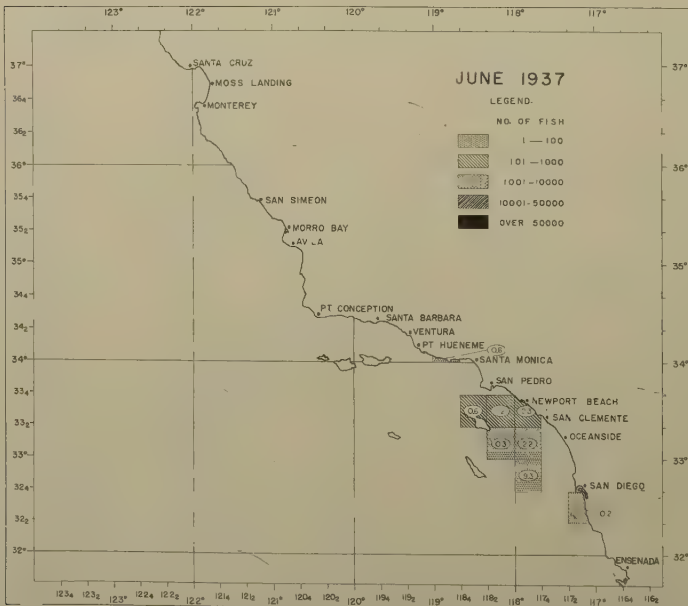
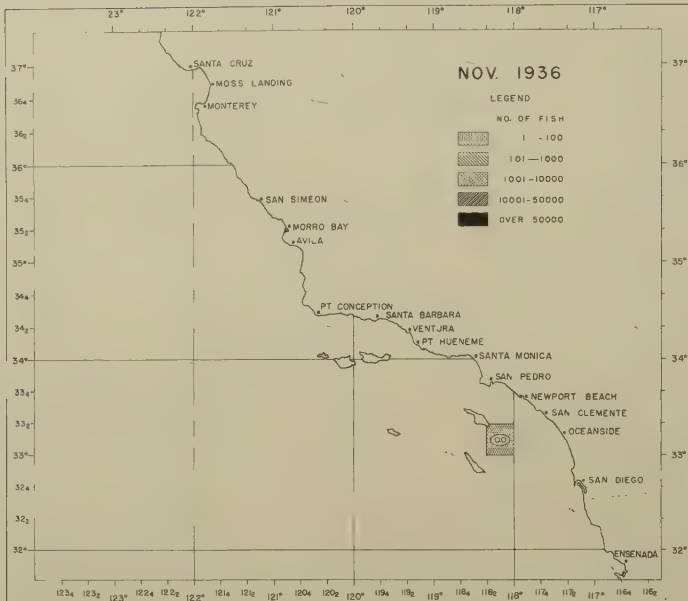


FIGURE 124. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

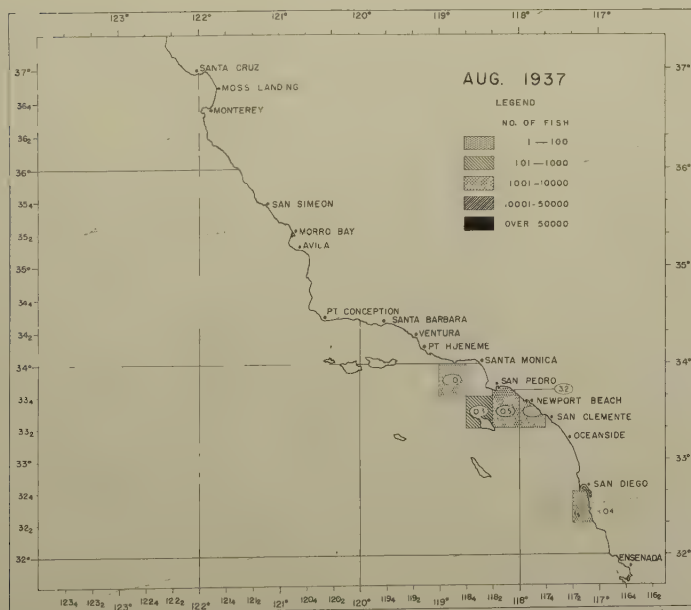
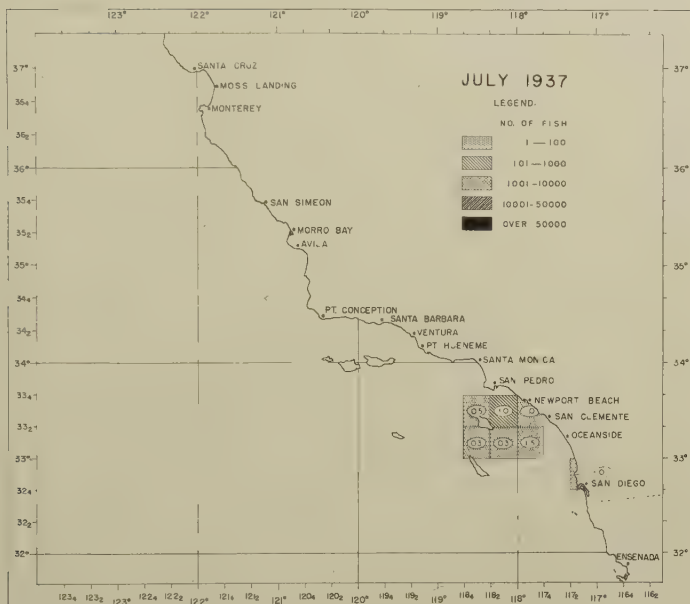


FIGURE 125. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

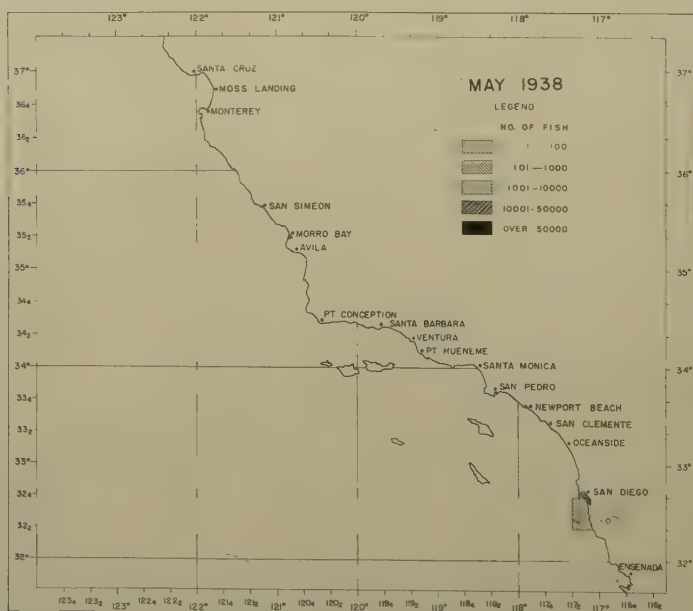
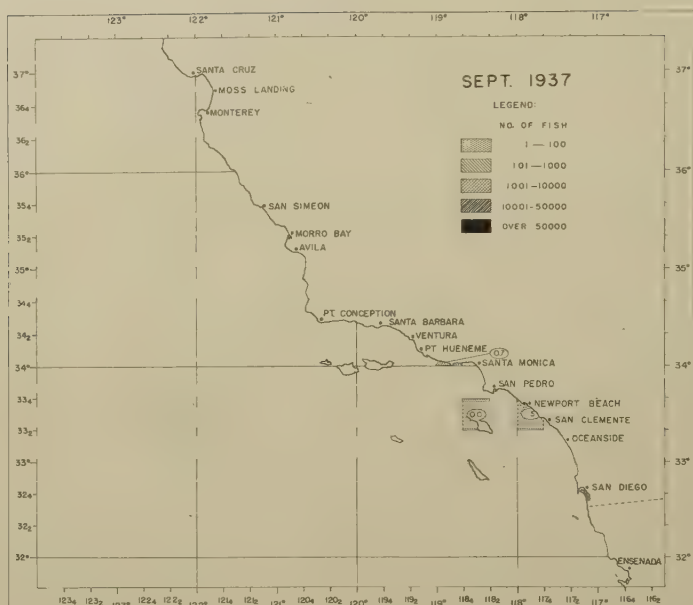


FIGURE 126. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

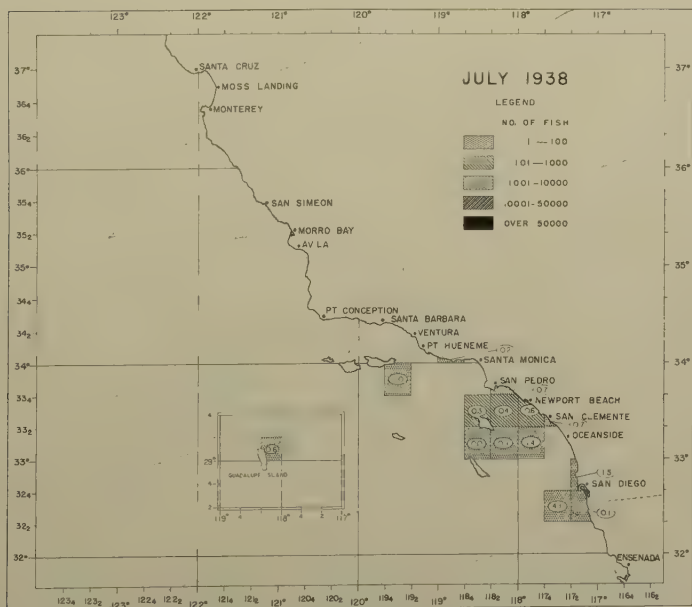
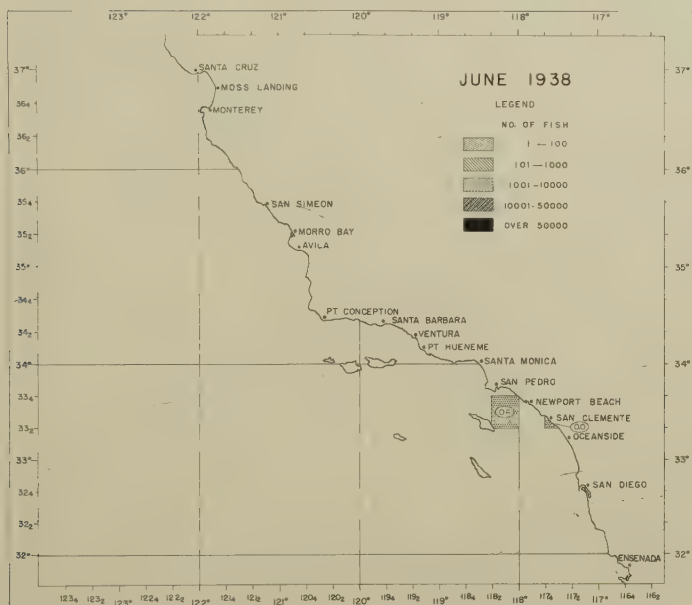


FIGURE 127. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

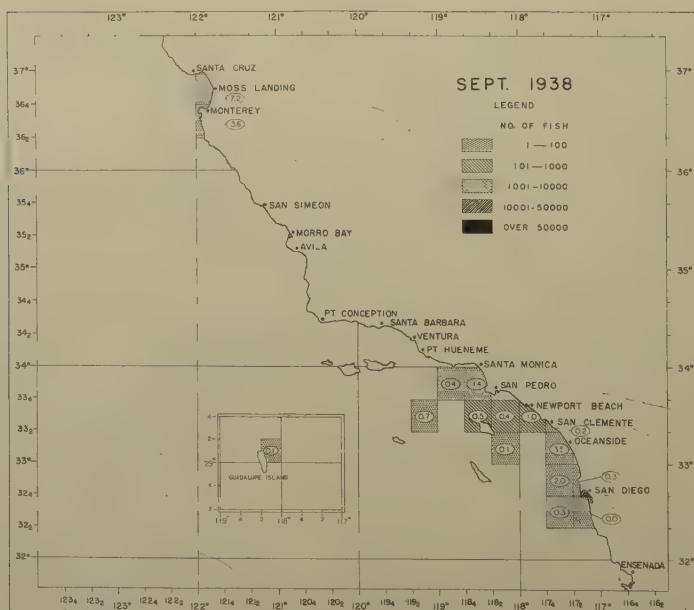
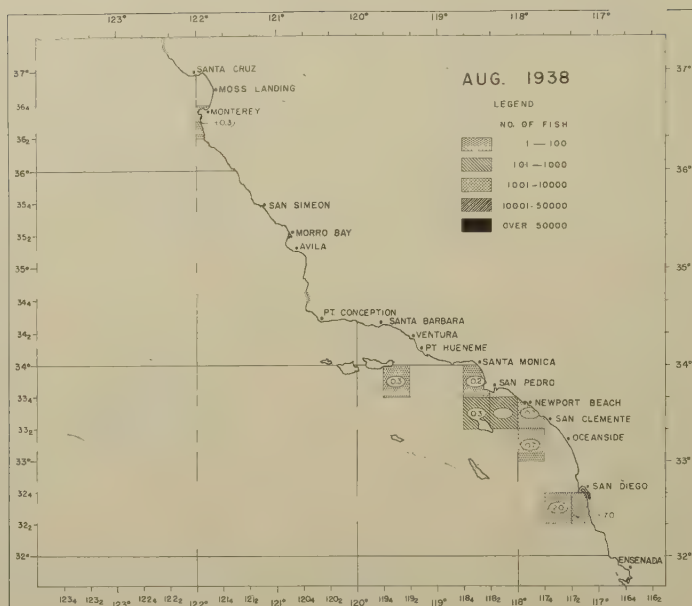


FIGURE 128. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

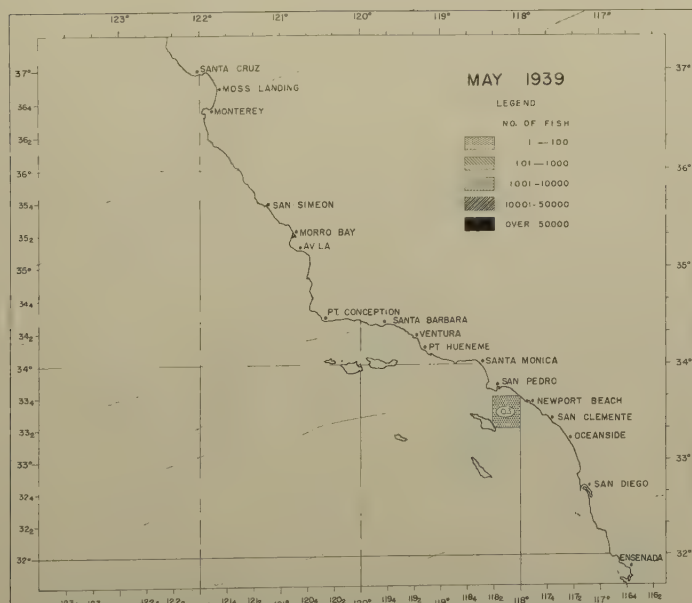
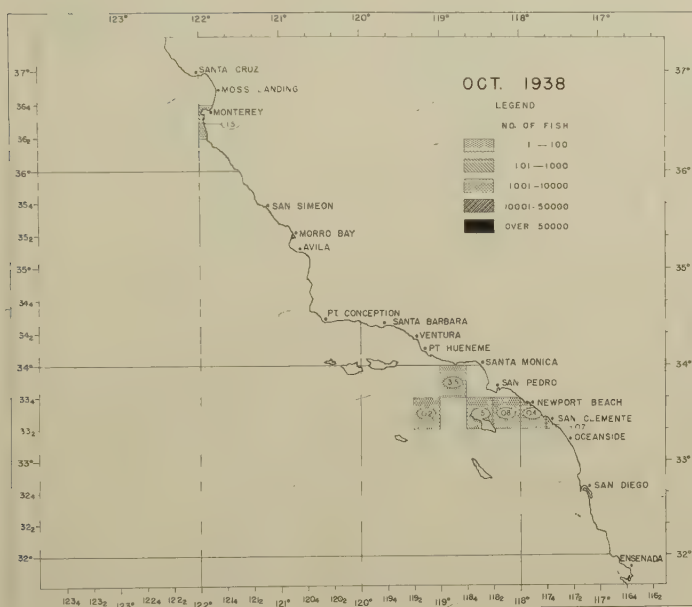


FIGURE 129. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

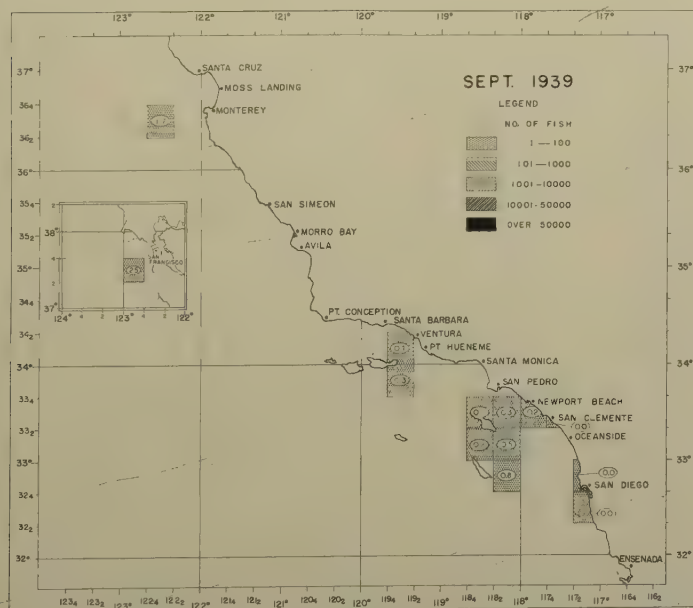
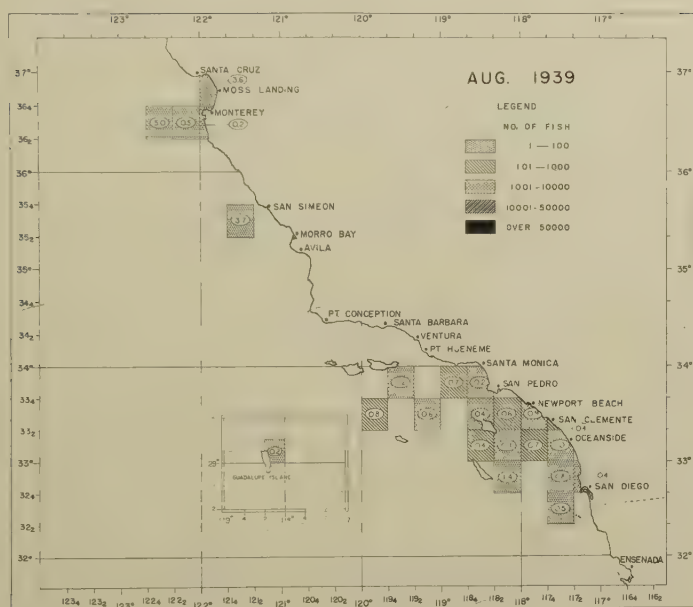


FIGURE 131. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

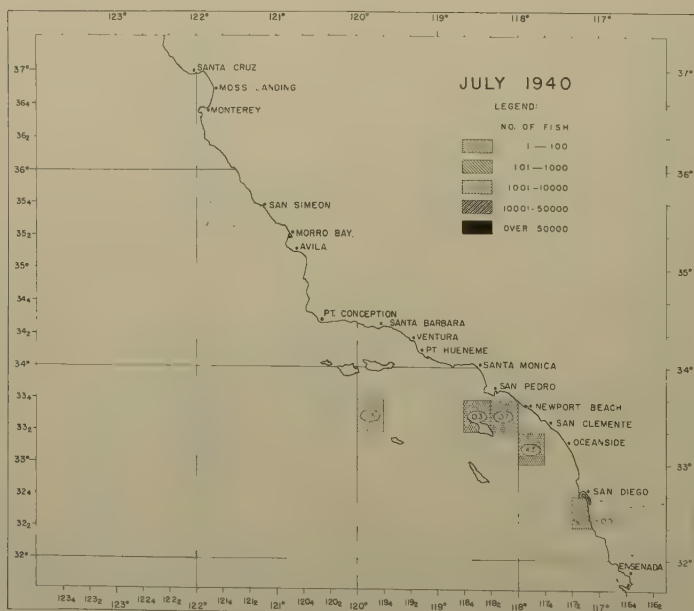
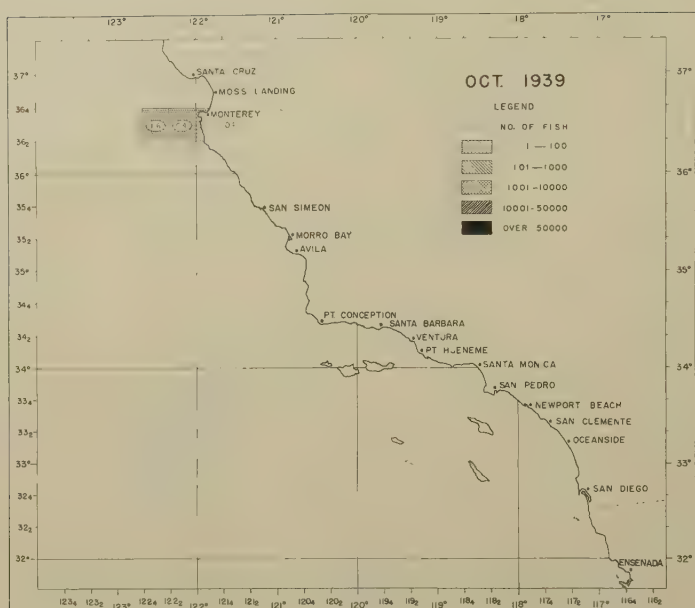


FIGURE 132. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

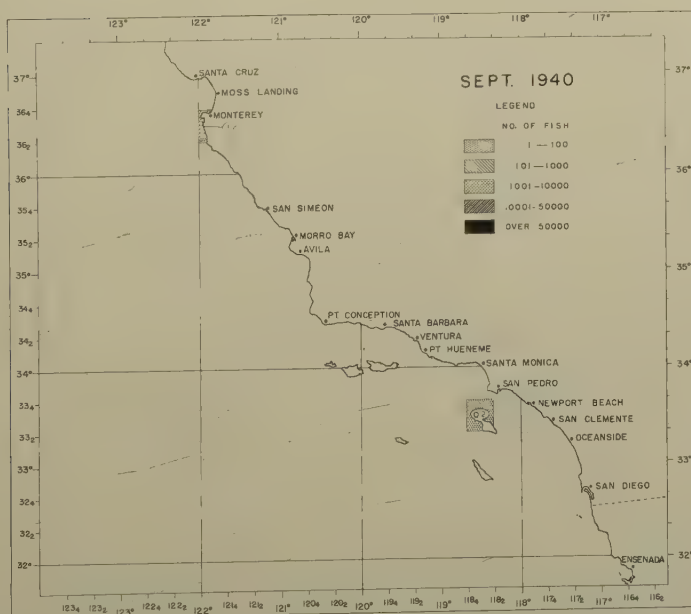
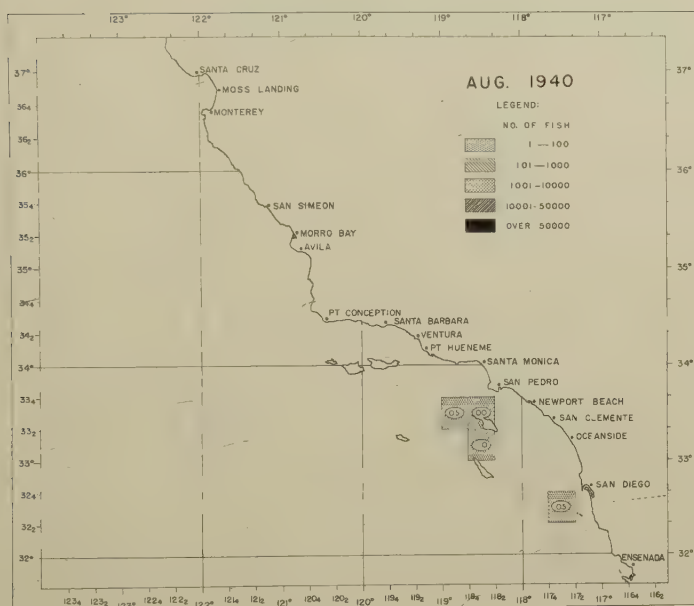


FIGURE 133. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

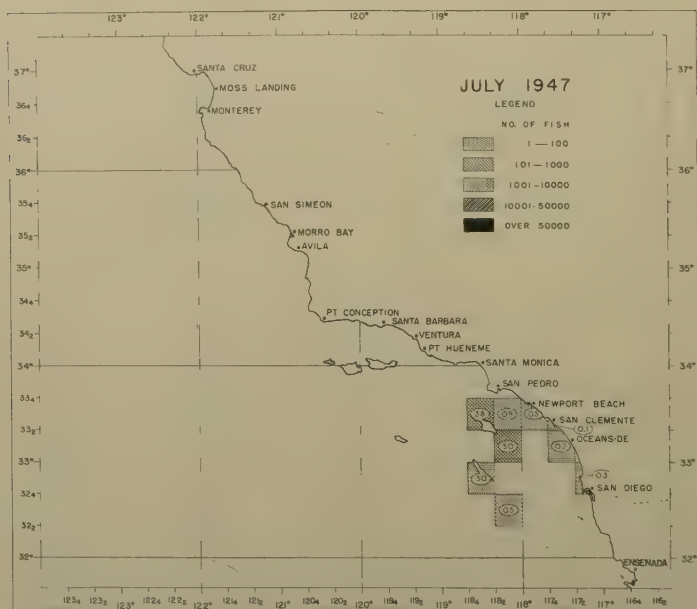
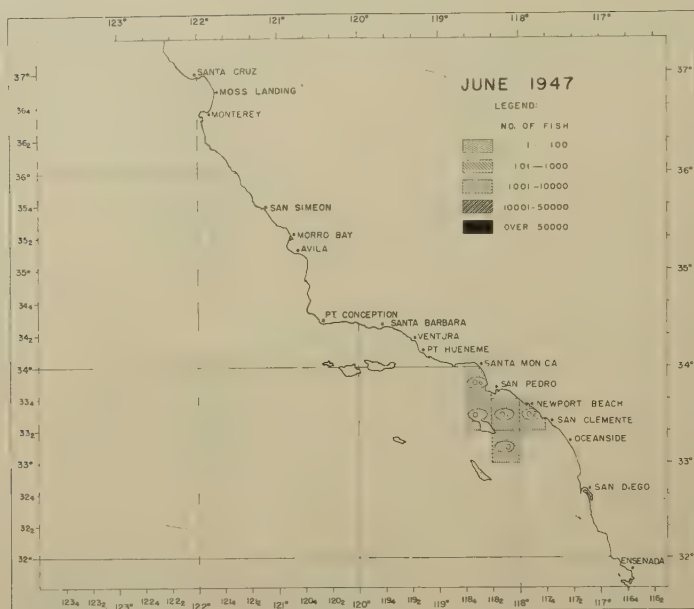


FIGURE 134. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

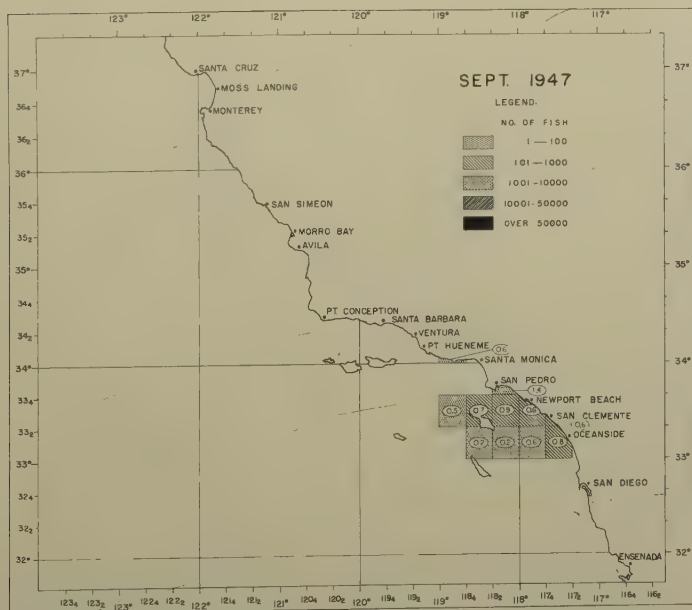
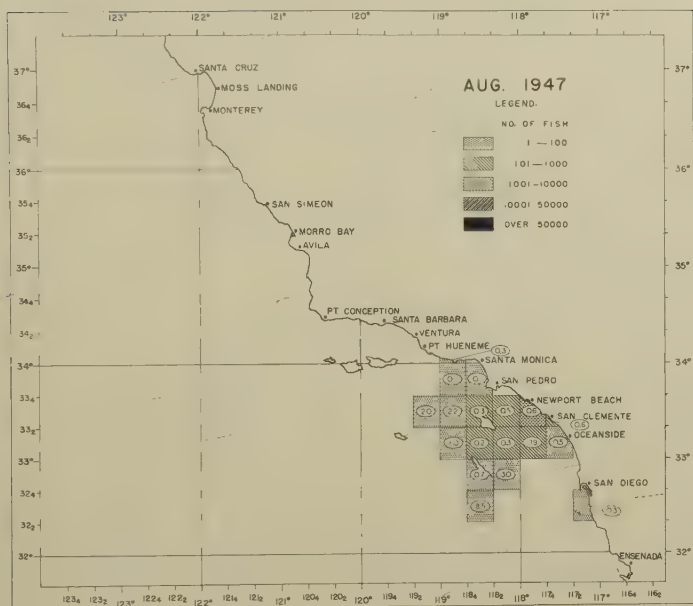


FIGURE 135. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

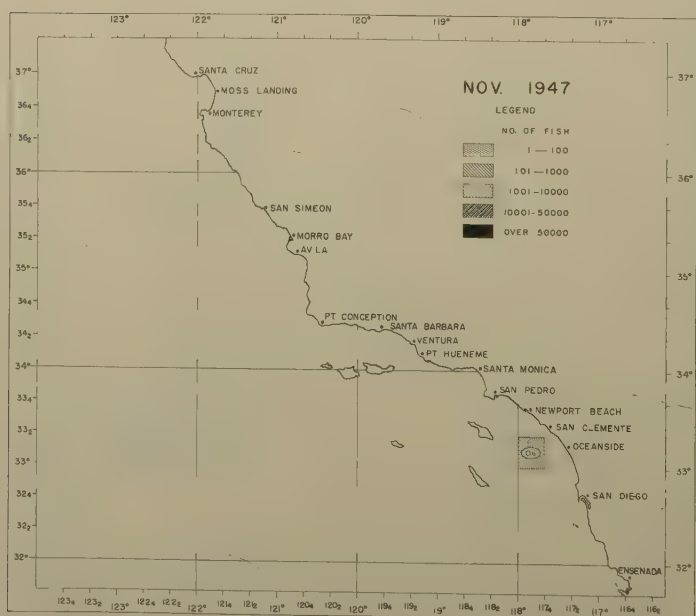
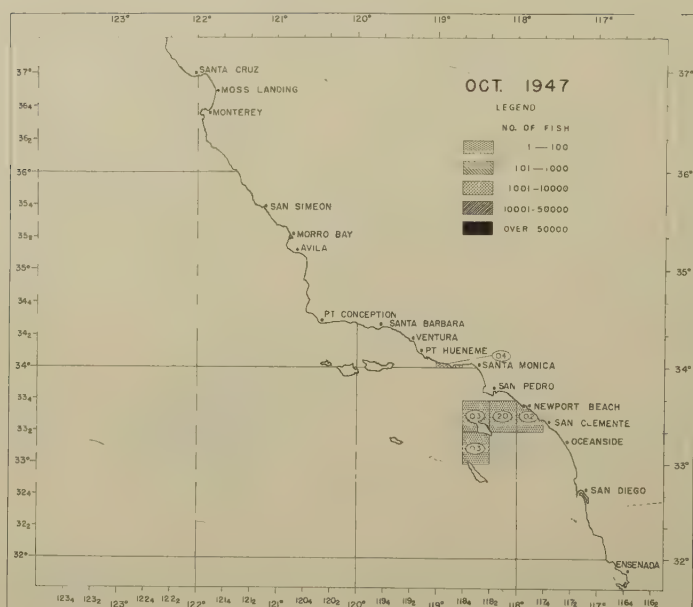


FIGURE 136. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

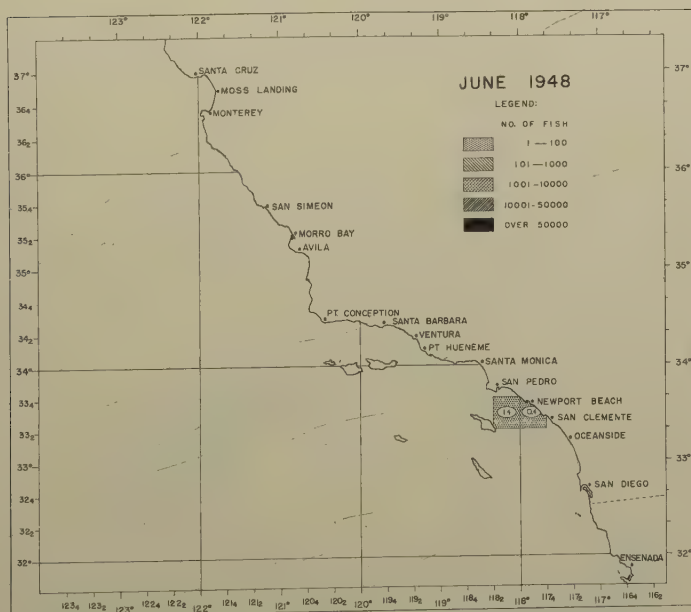
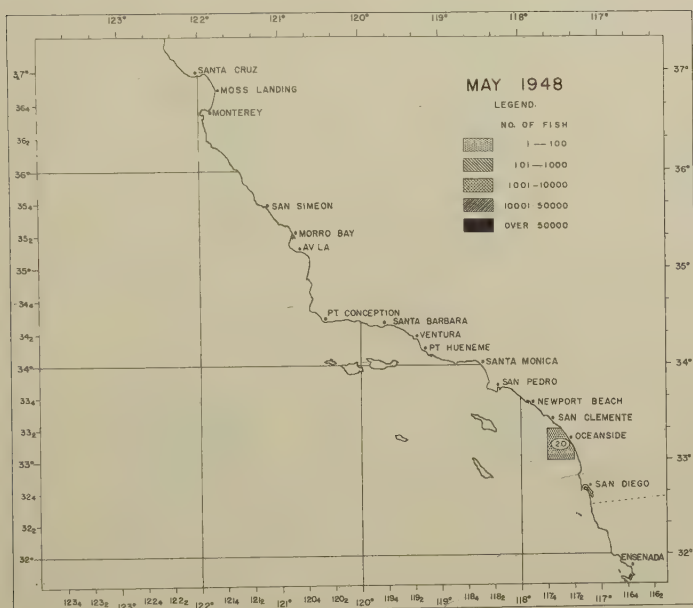


FIGURE 137. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

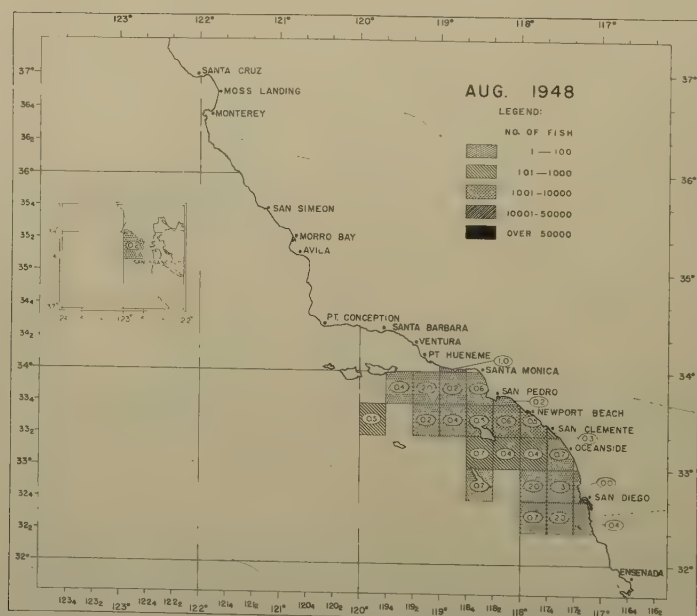
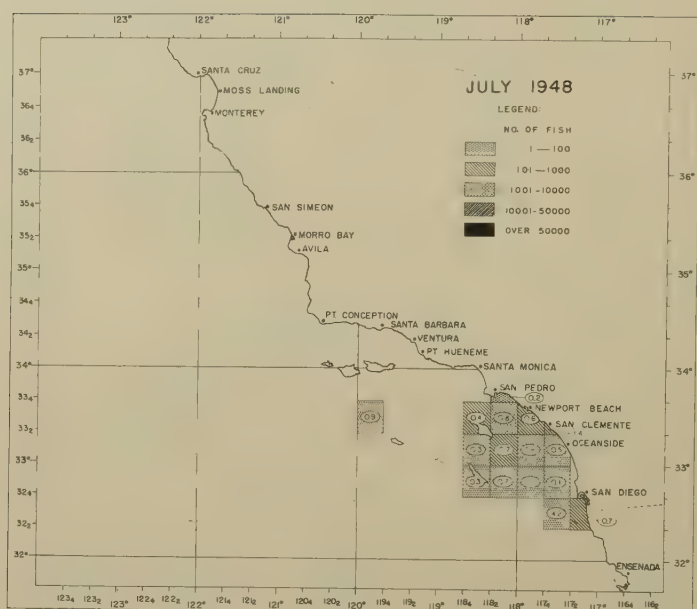


FIGURE 138. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

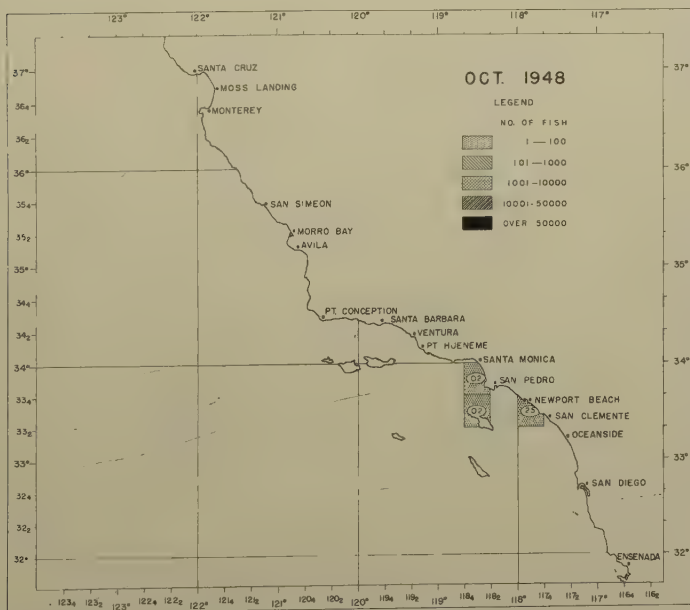
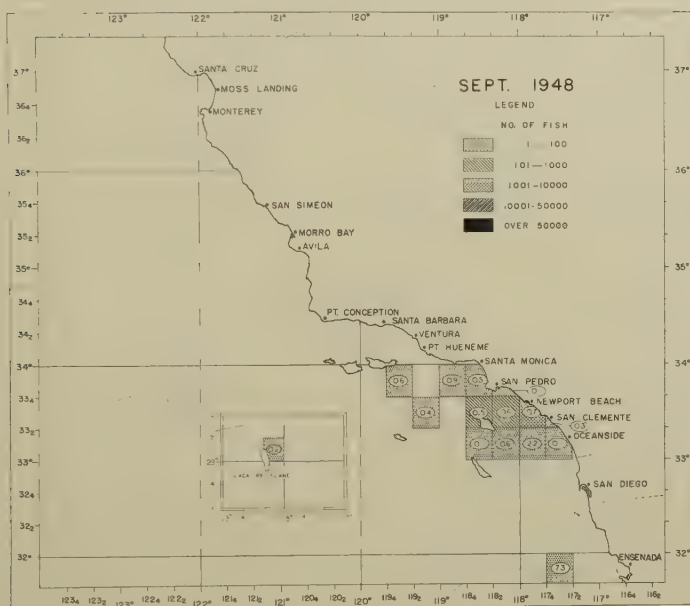


FIGURE 139. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

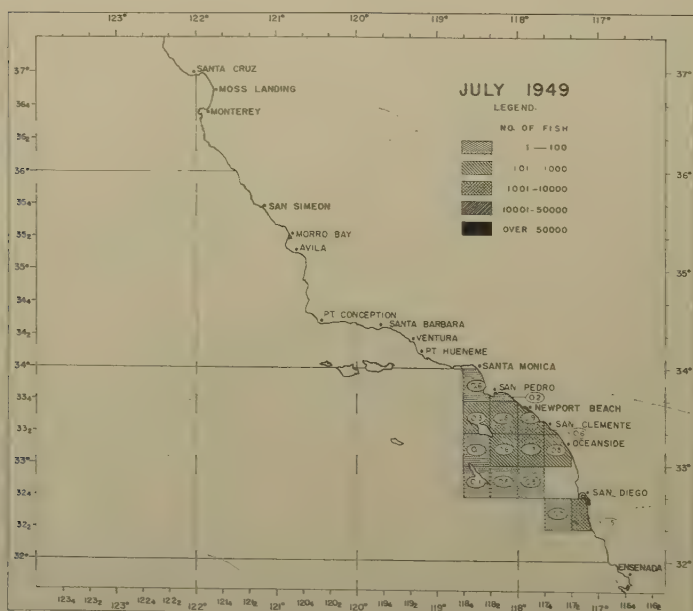
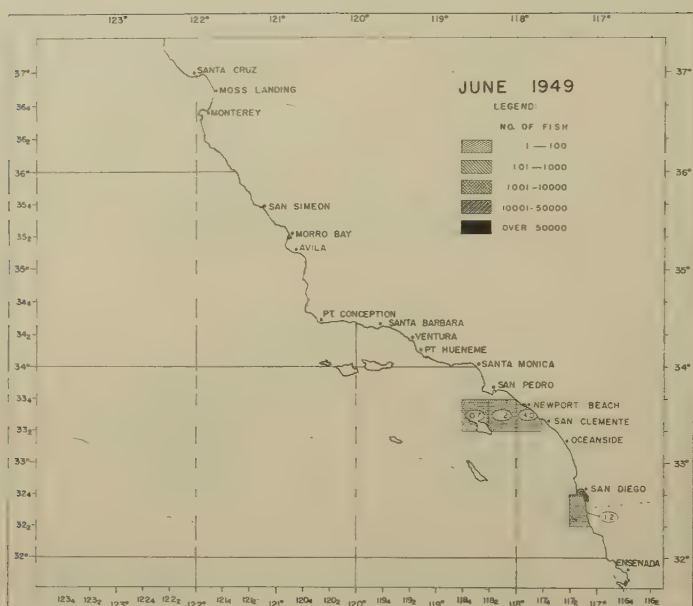


FIGURE 140. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

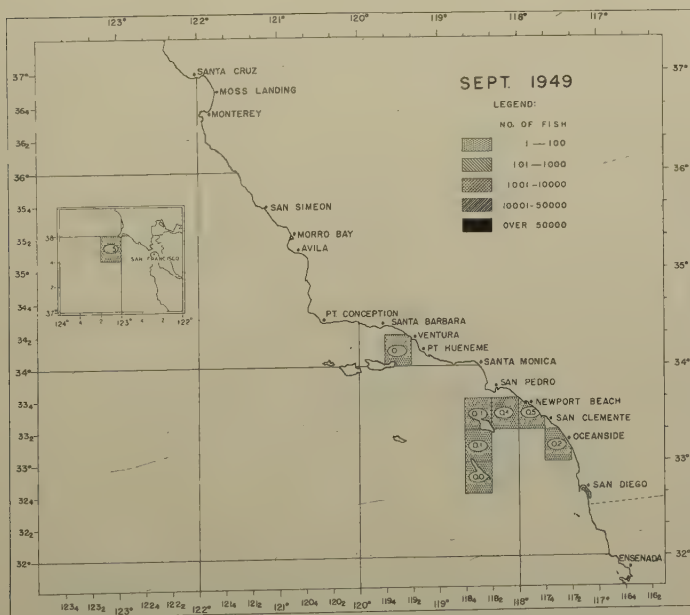
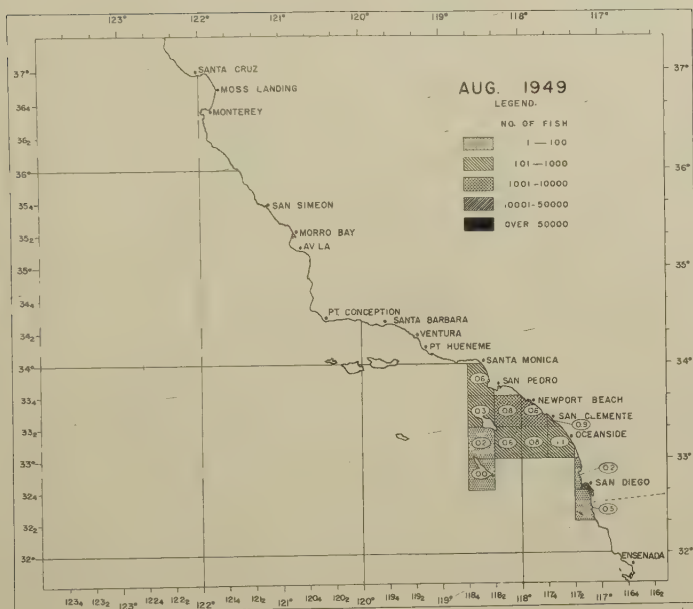


FIGURE 141. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

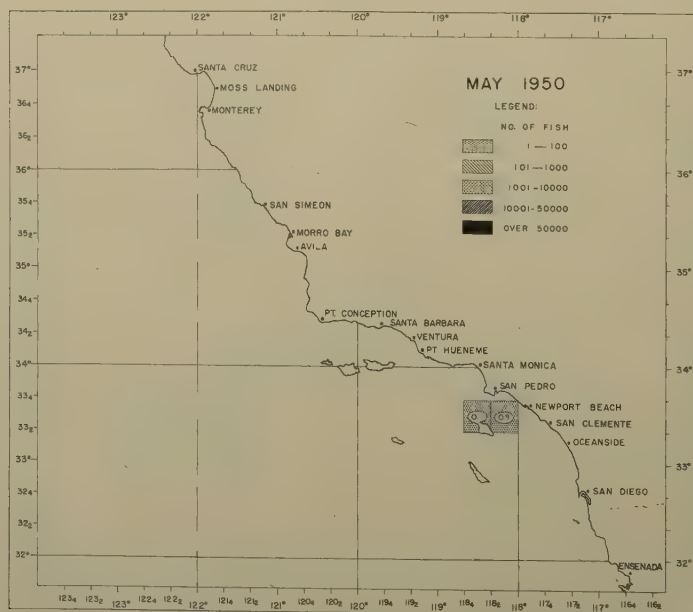
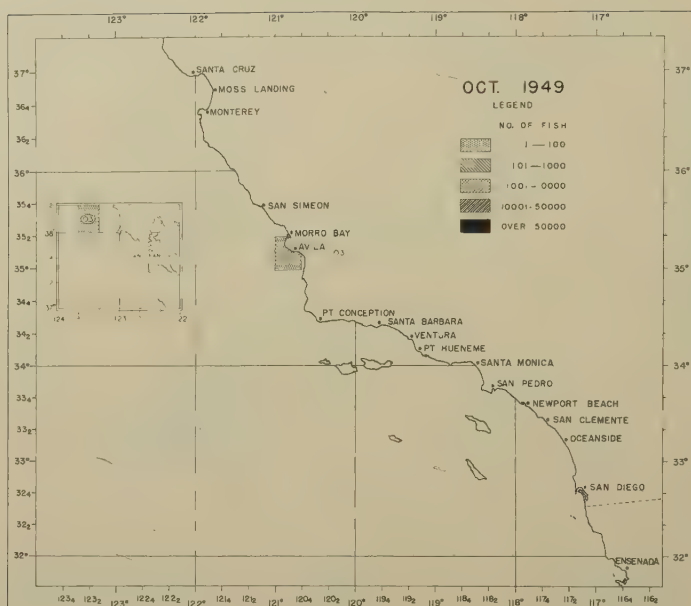


FIGURE 142. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

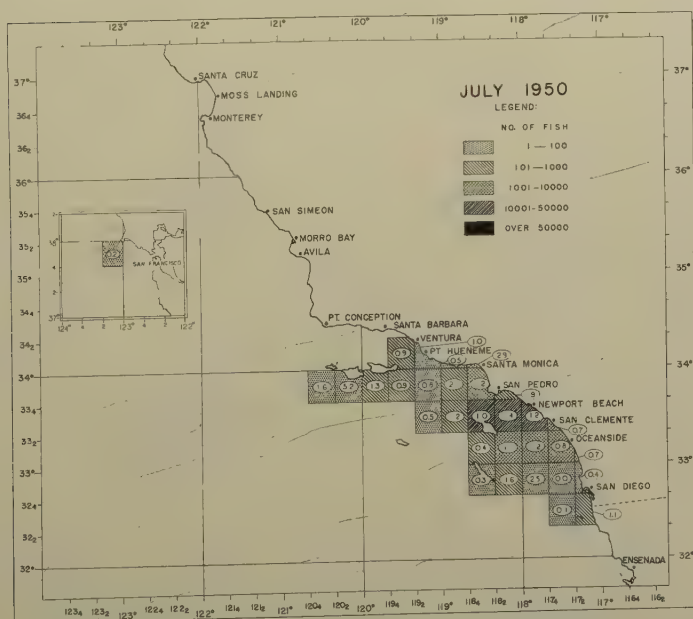
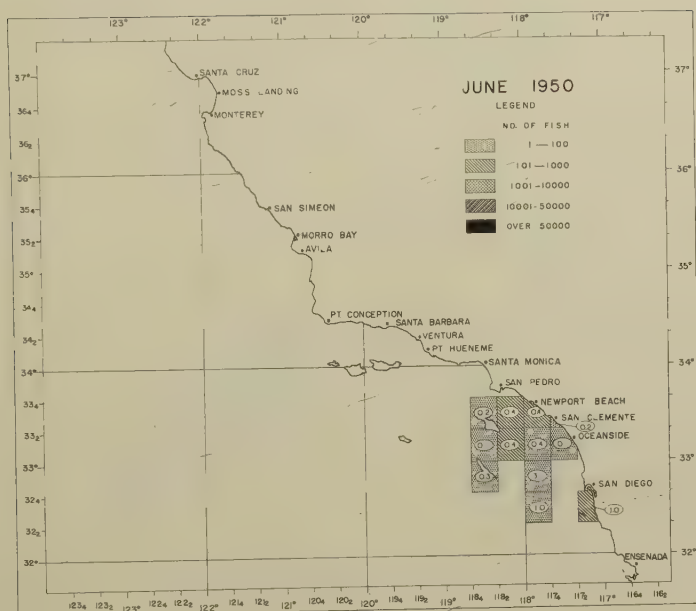


FIGURE 143. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

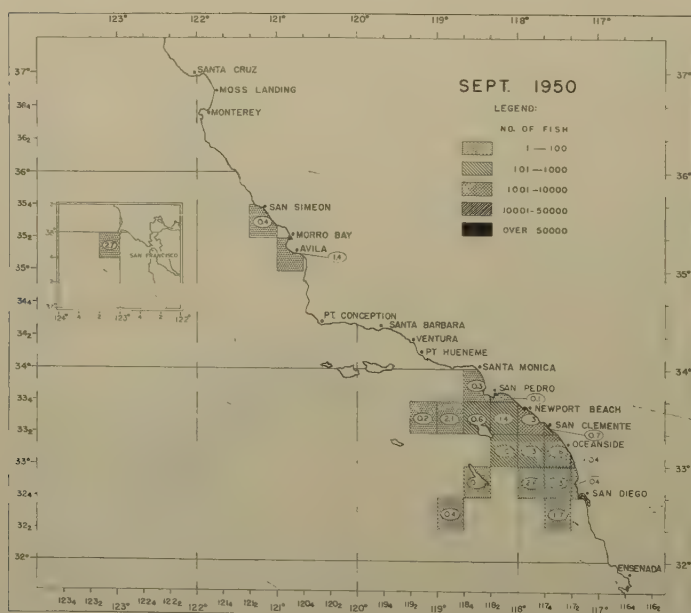
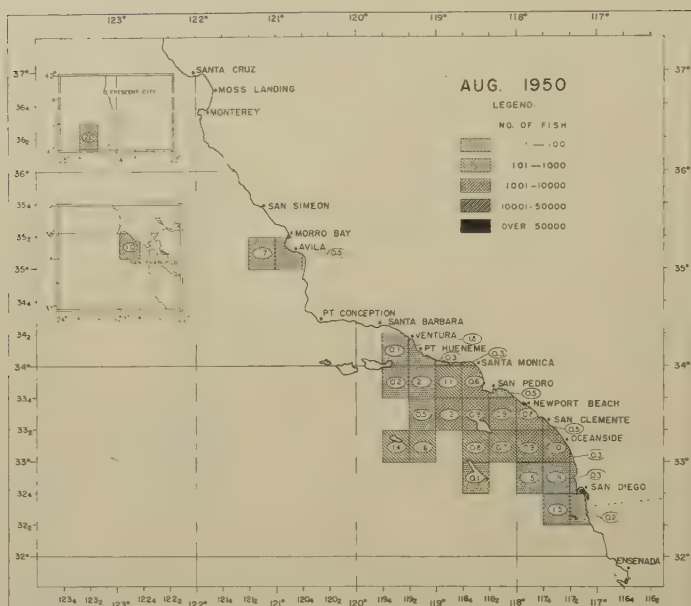


FIGURE 144. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

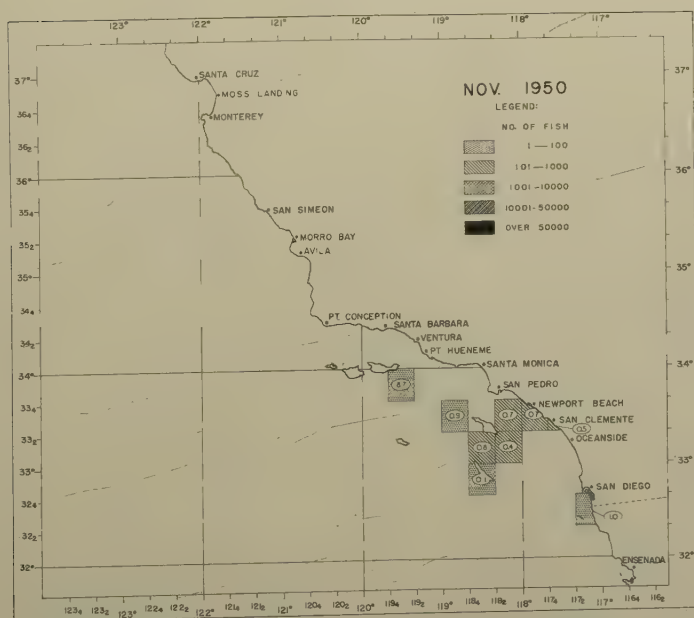
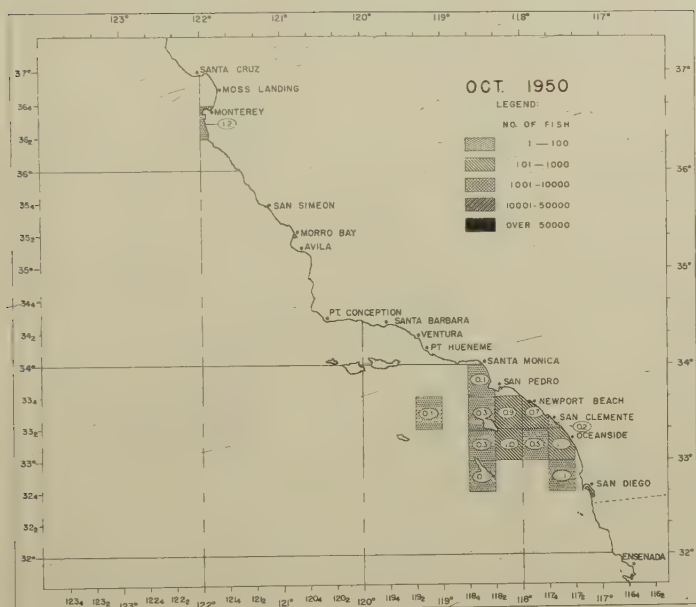


FIGURE 145. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

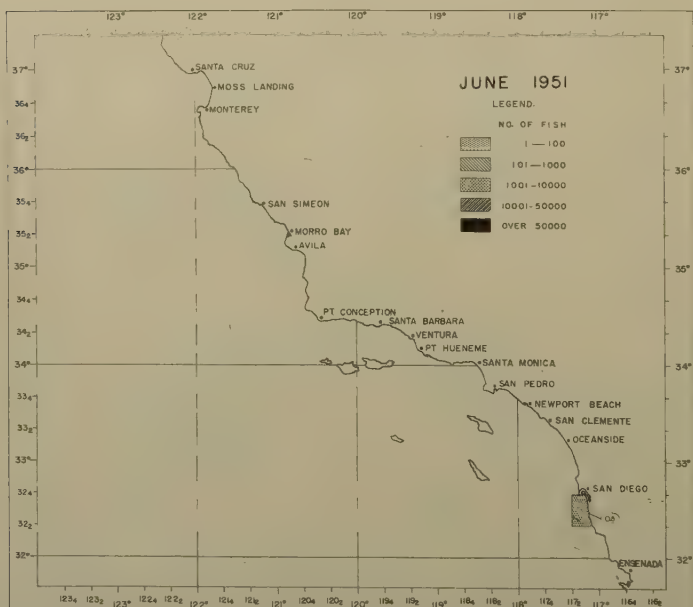
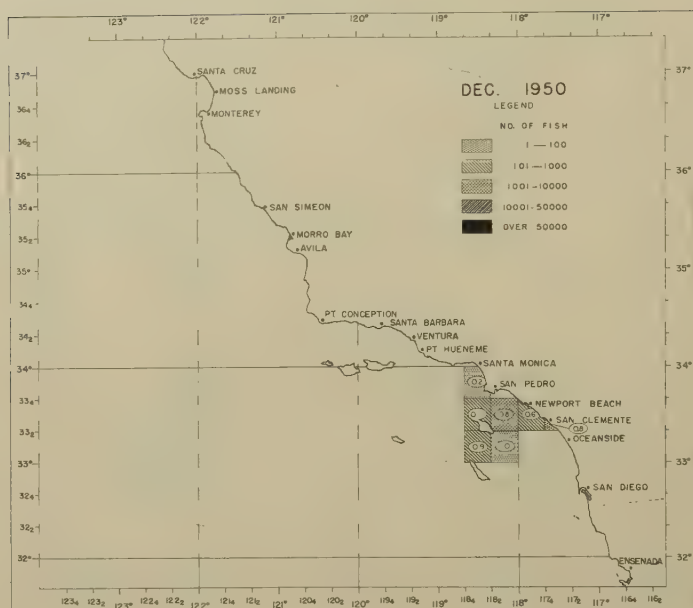


FIGURE 146. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

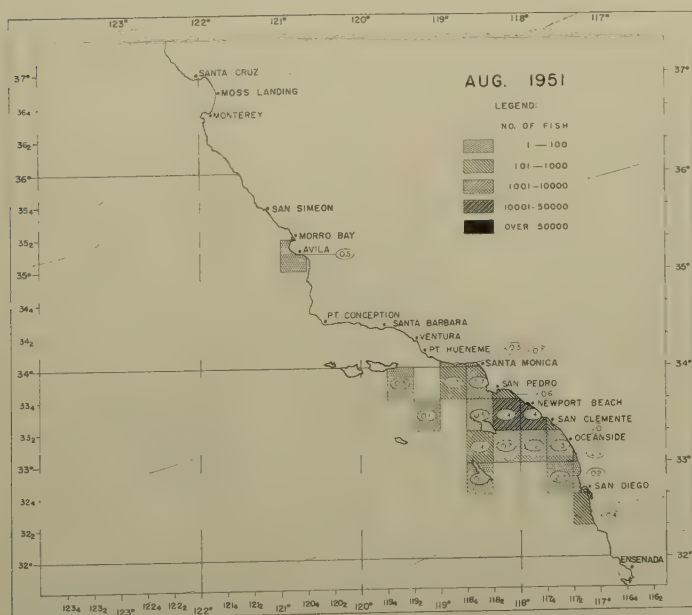
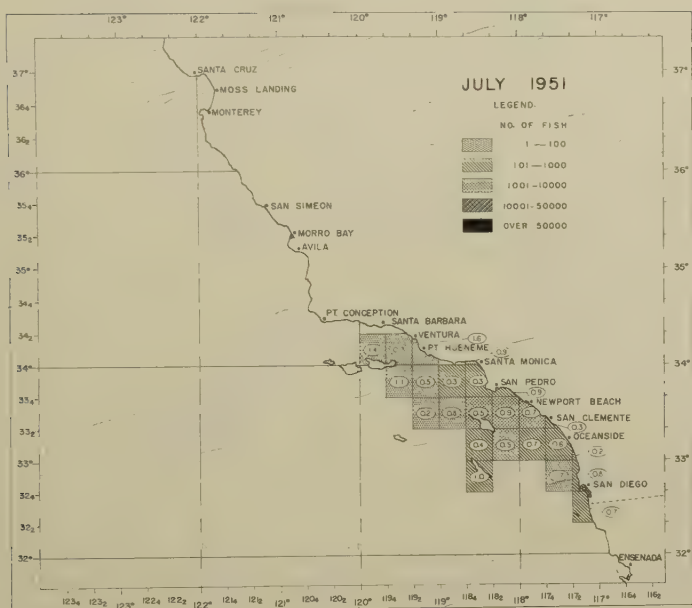


FIGURE 147. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

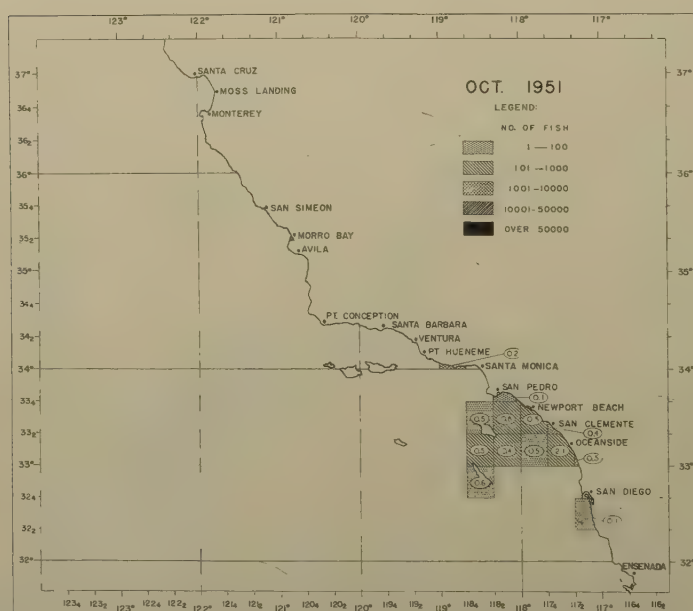
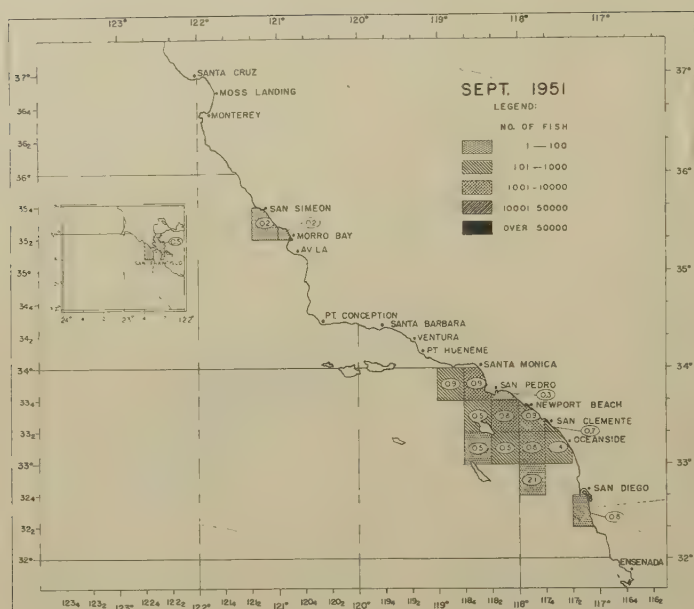


FIGURE 148. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

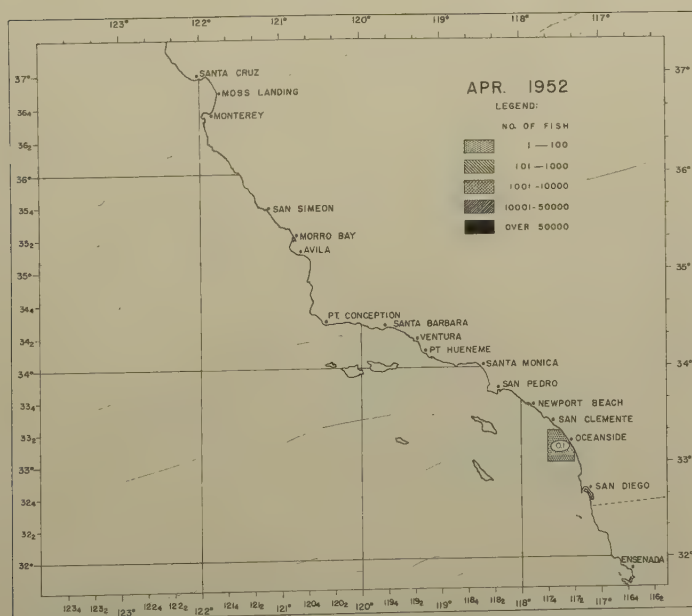
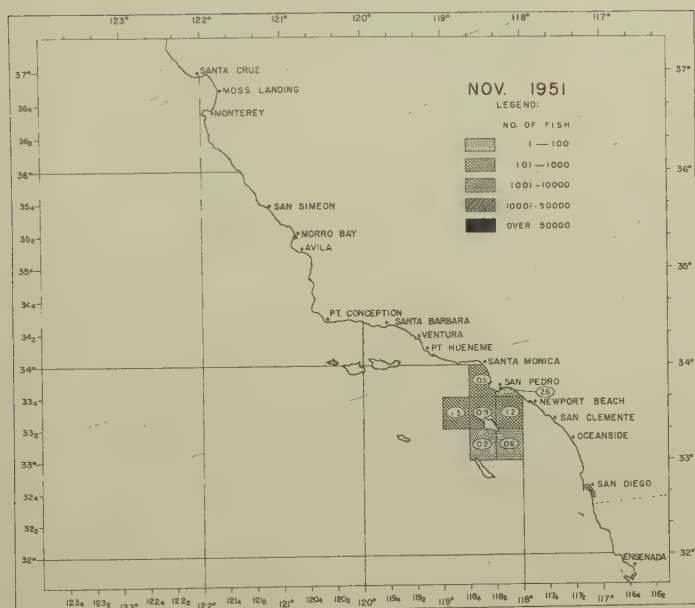


FIGURE 149. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

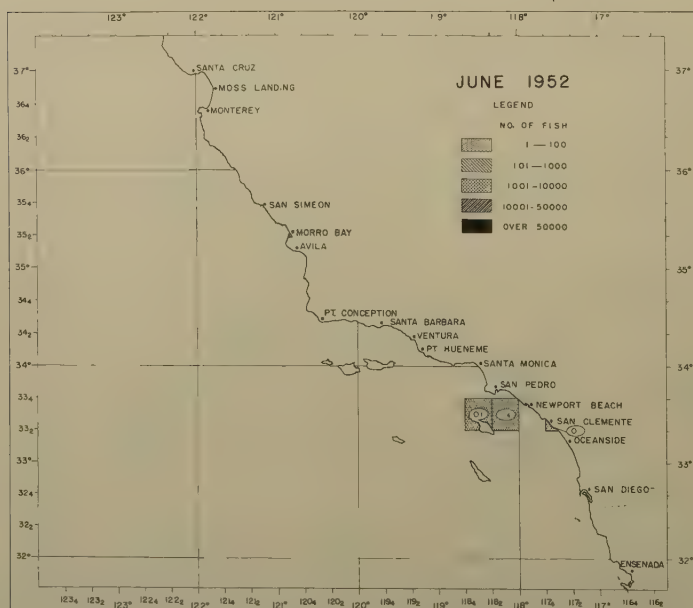
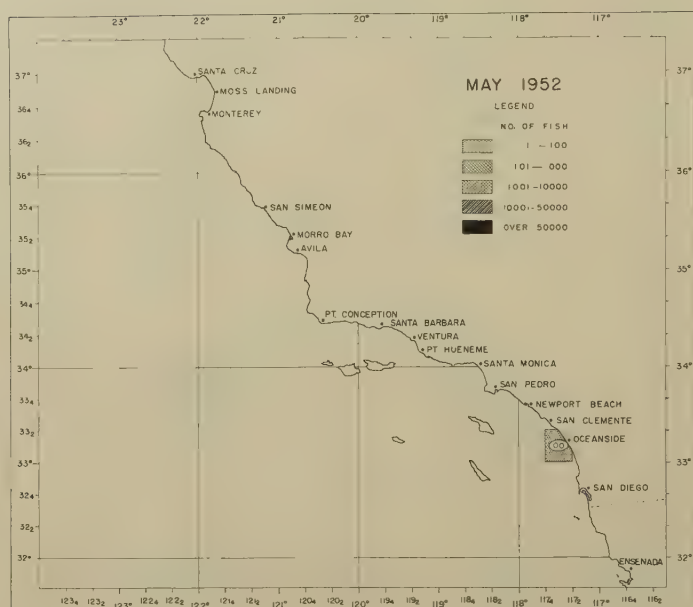


FIGURE 150. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

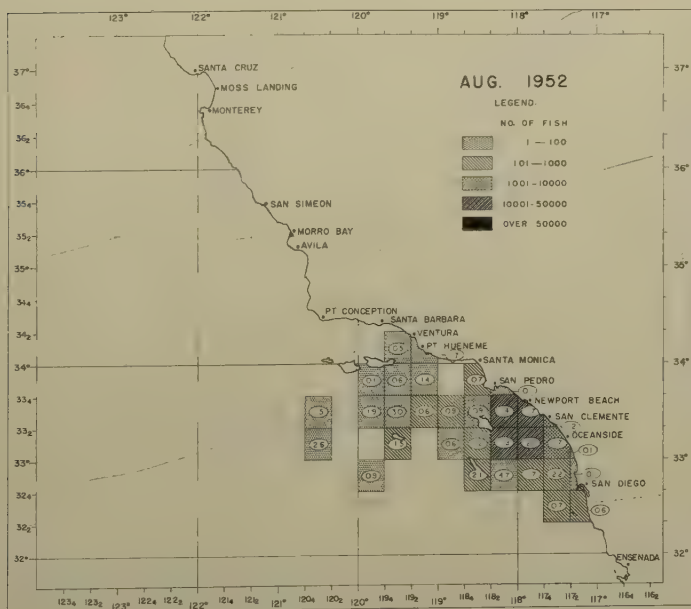
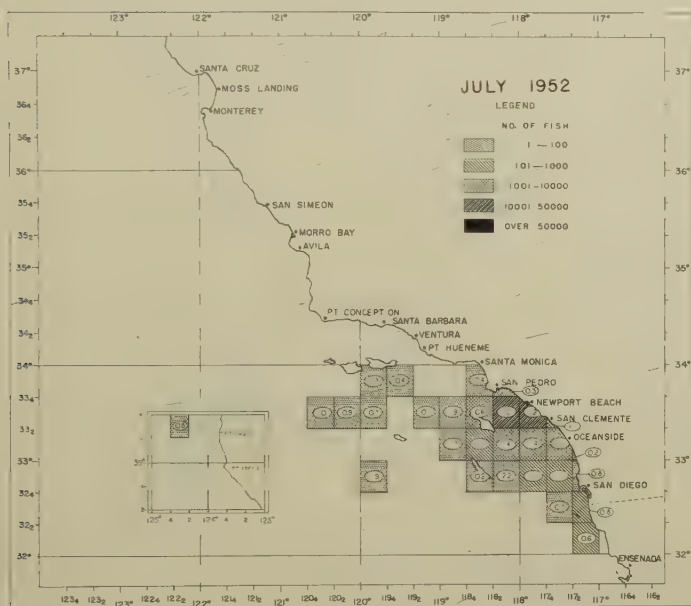


FIGURE 151. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

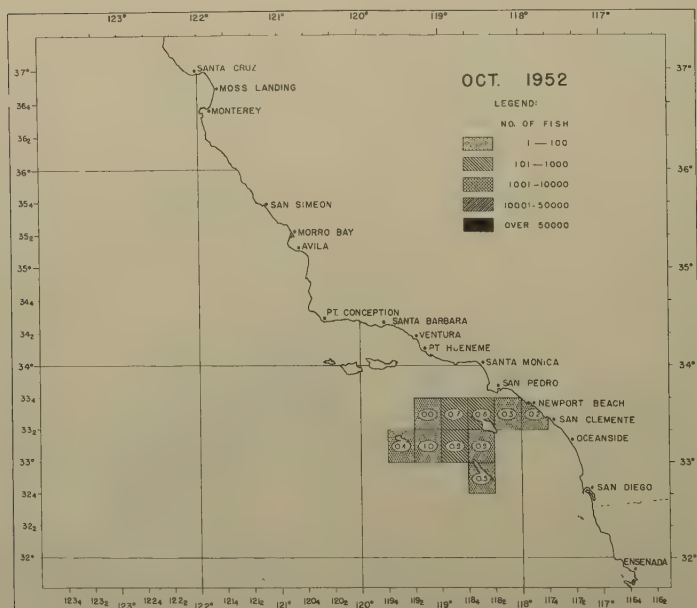
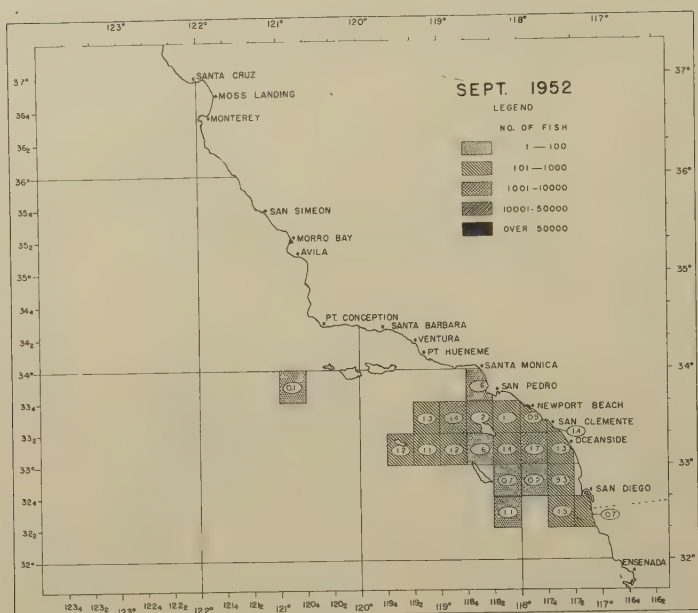


FIGURE 152. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

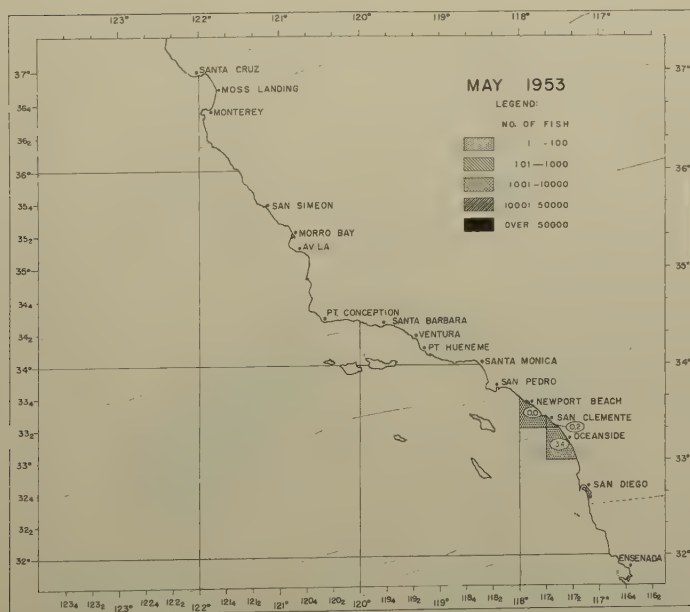
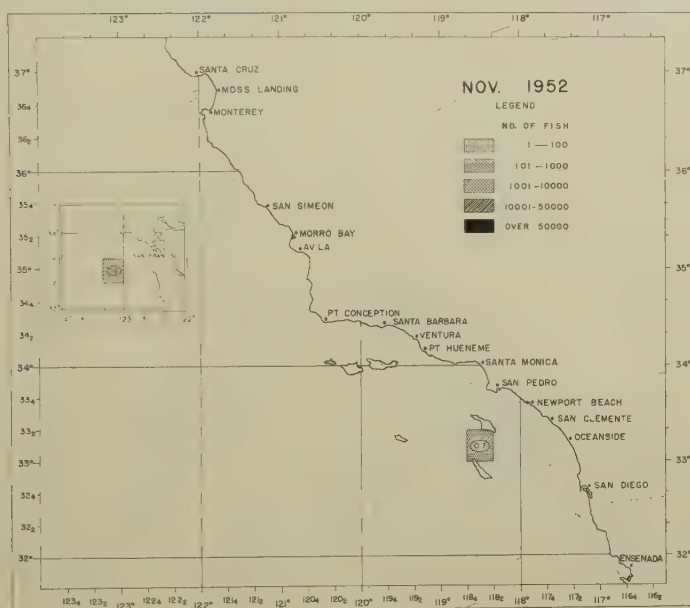


FIGURE 153. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

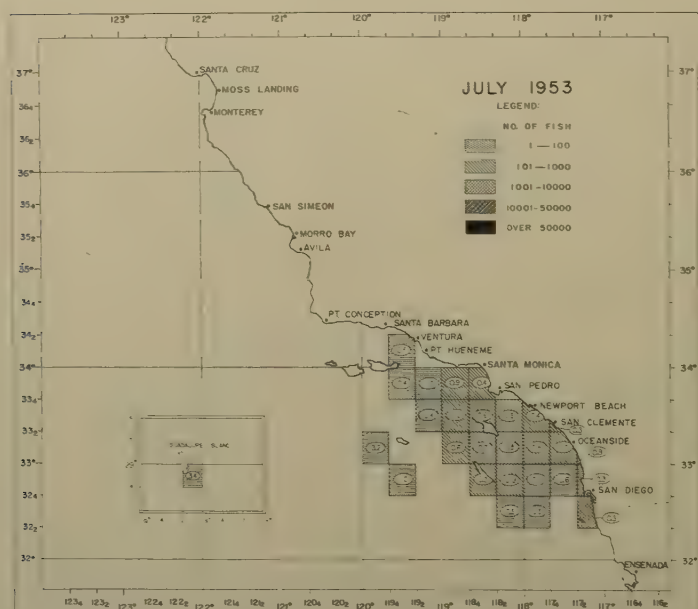
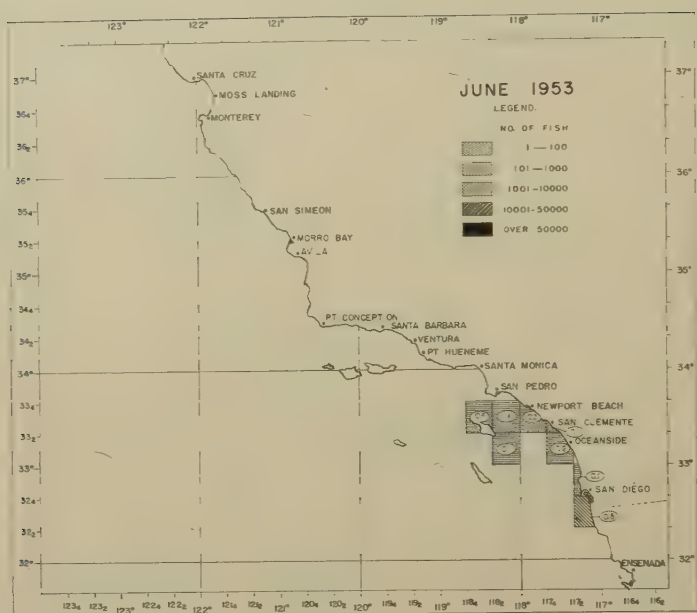


FIGURE 154. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

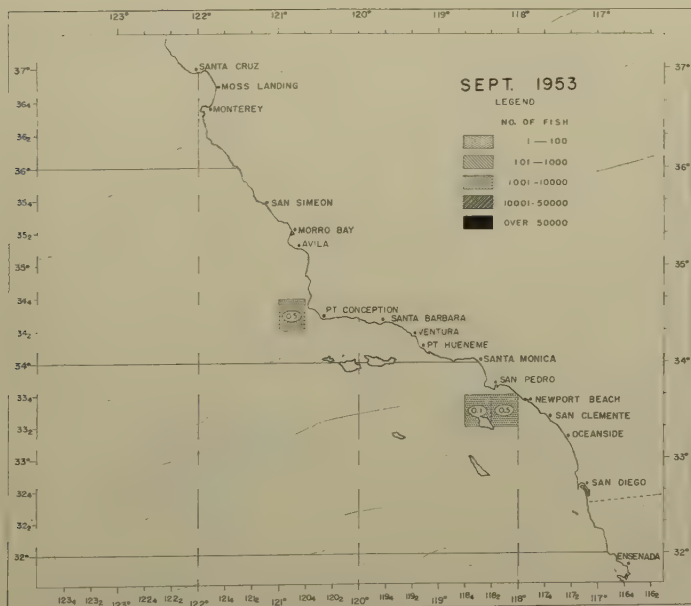
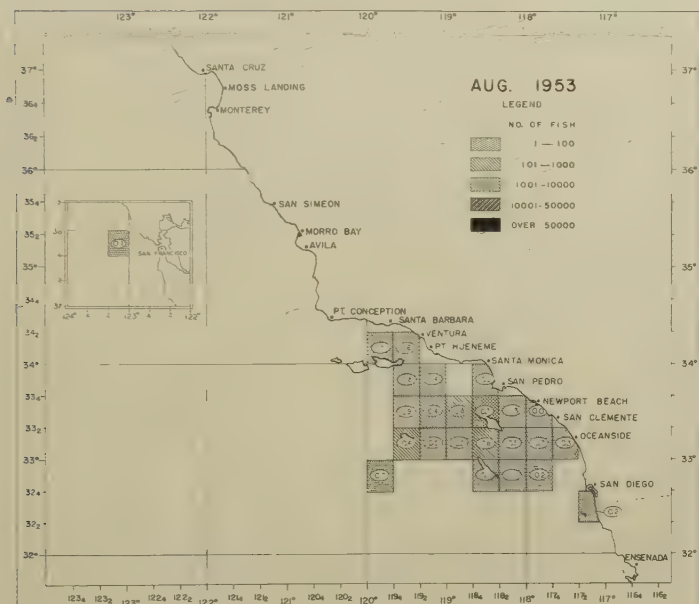


FIGURE 155. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

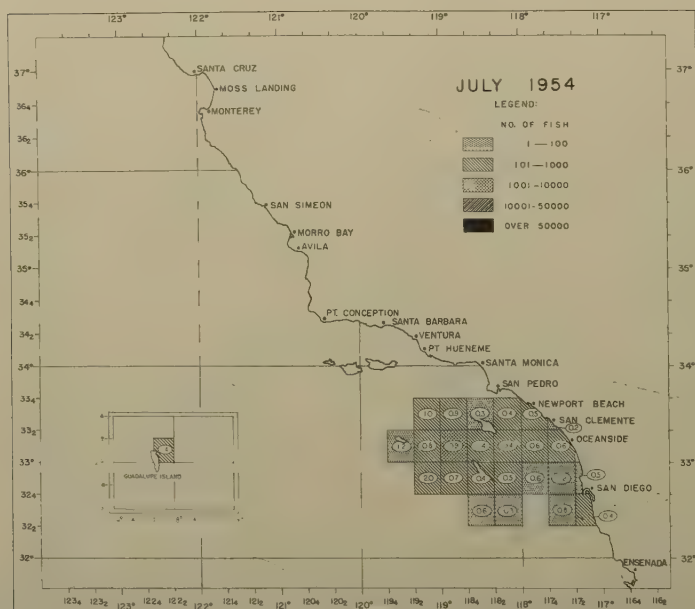
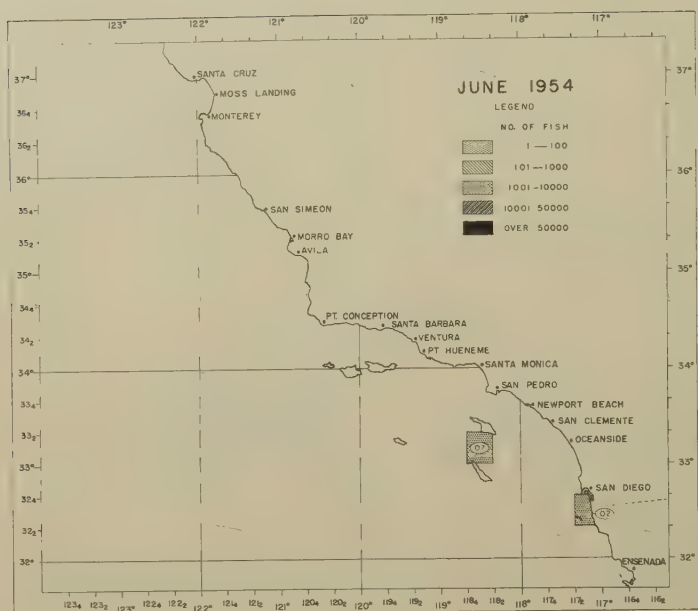


FIGURE 156. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

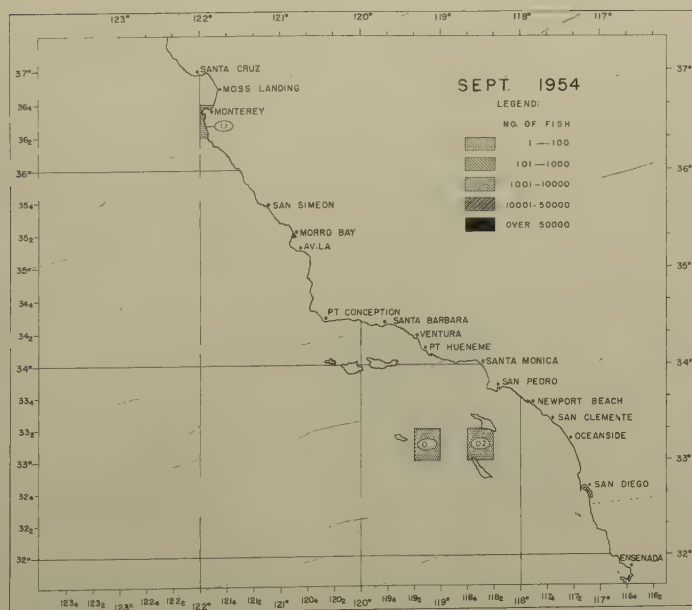
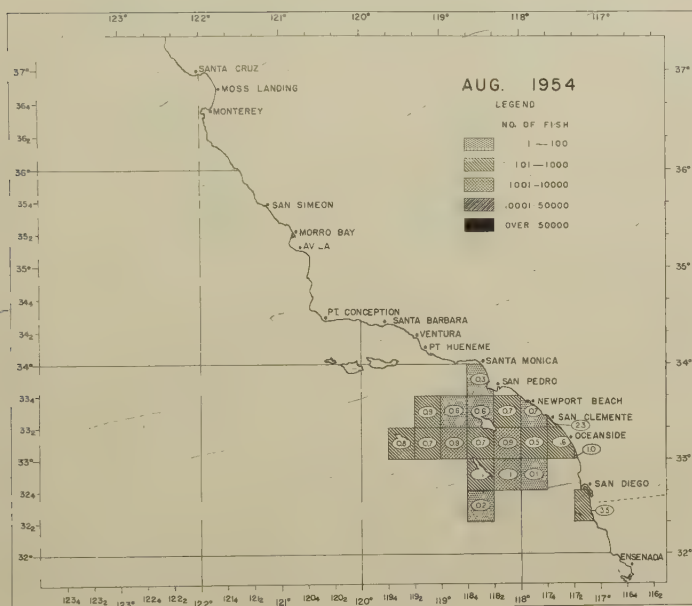


FIGURE 157. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

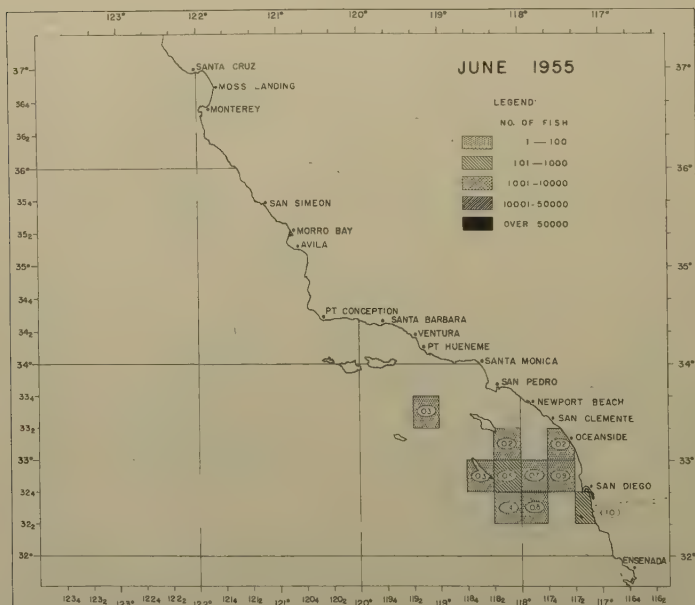
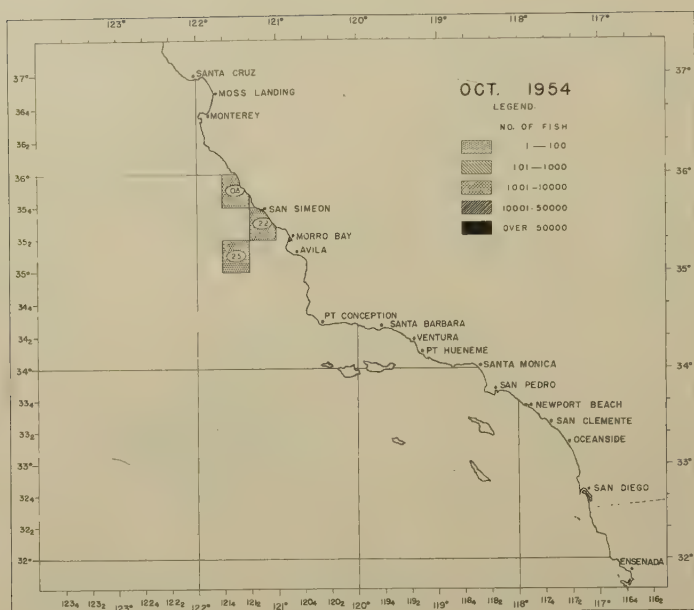


FIGURE 158. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

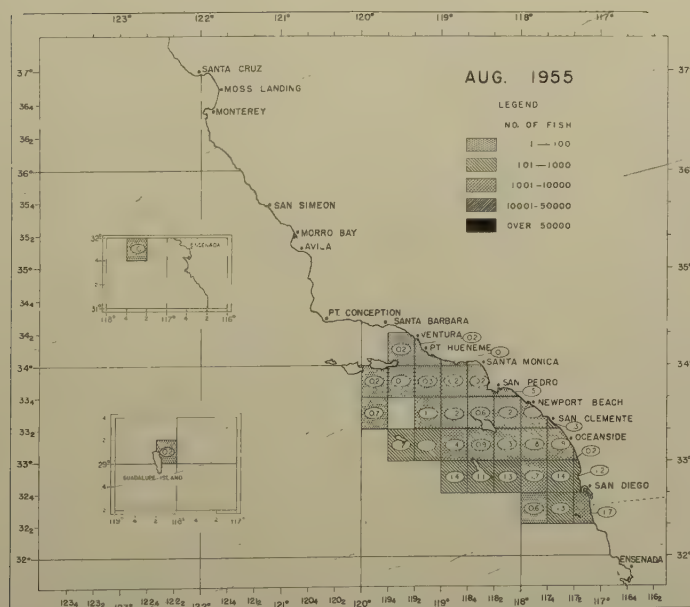
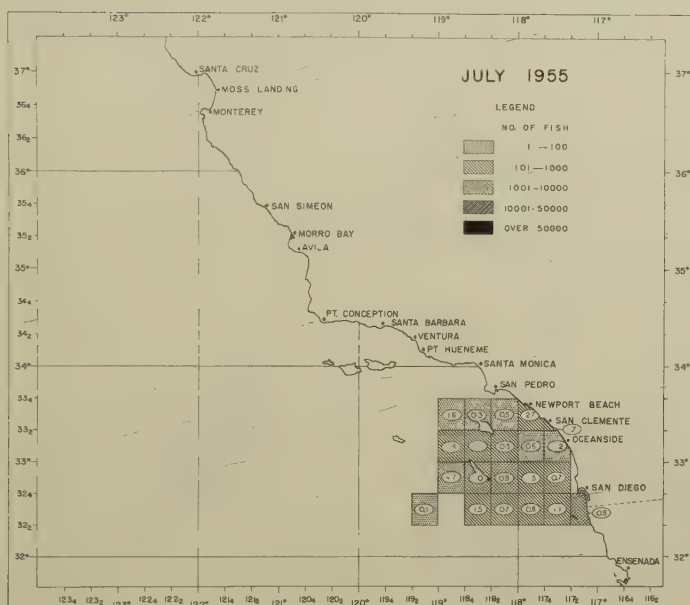


FIGURE 159. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

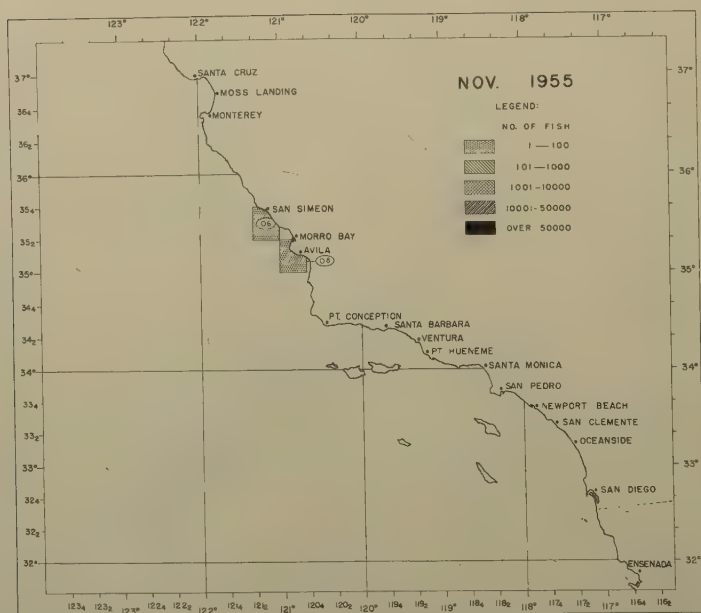
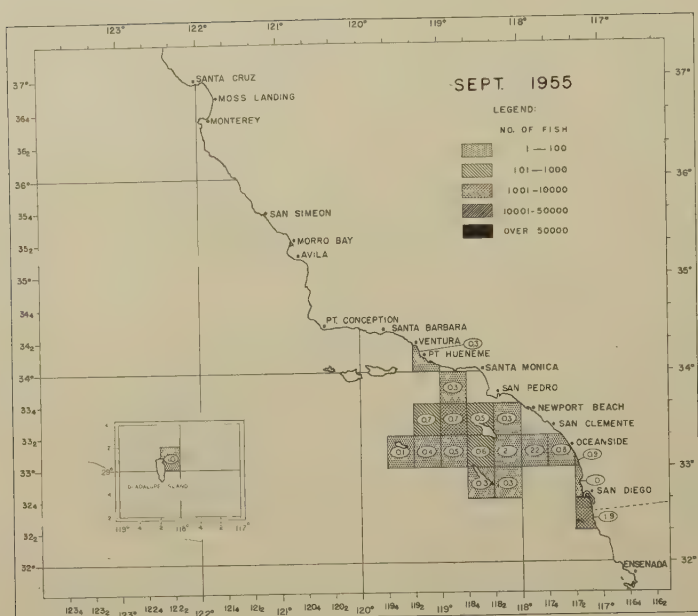


FIGURE 160. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

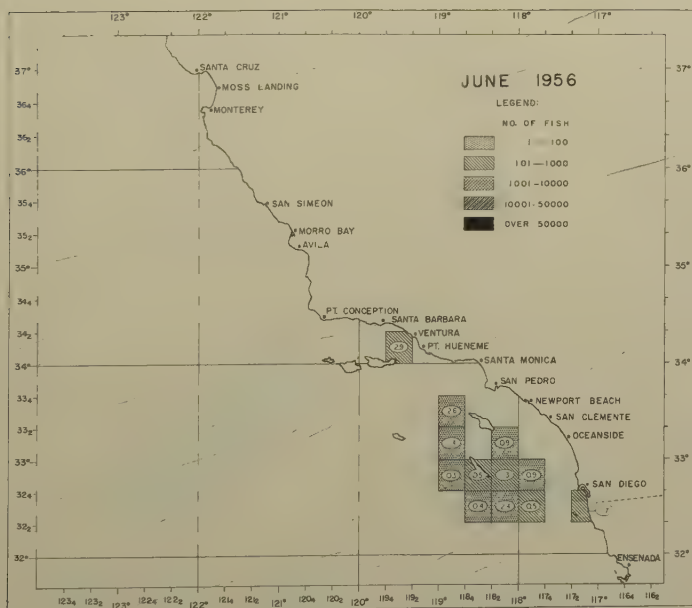
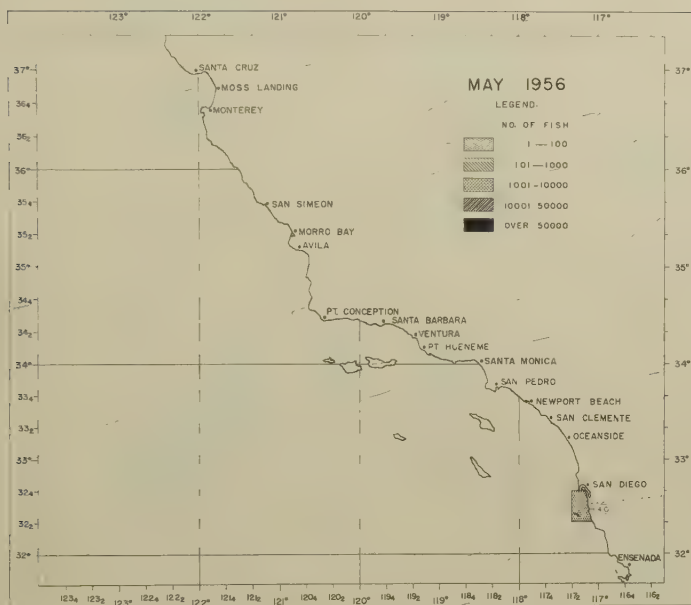


FIGURE 161. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

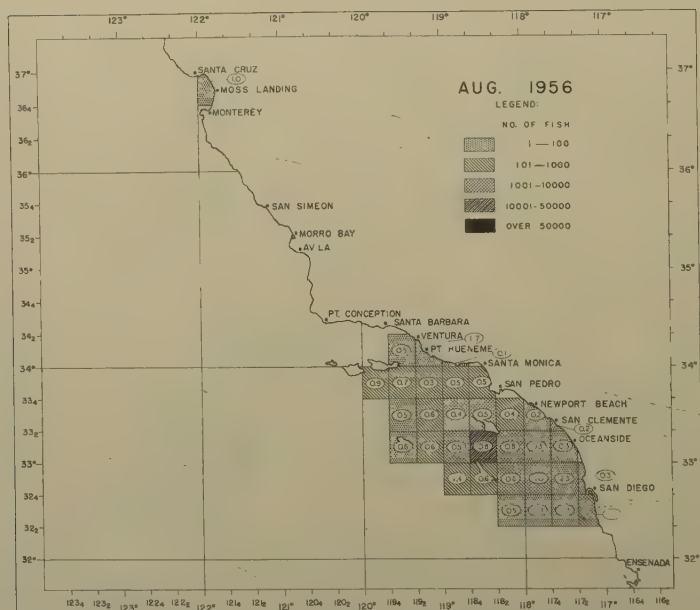
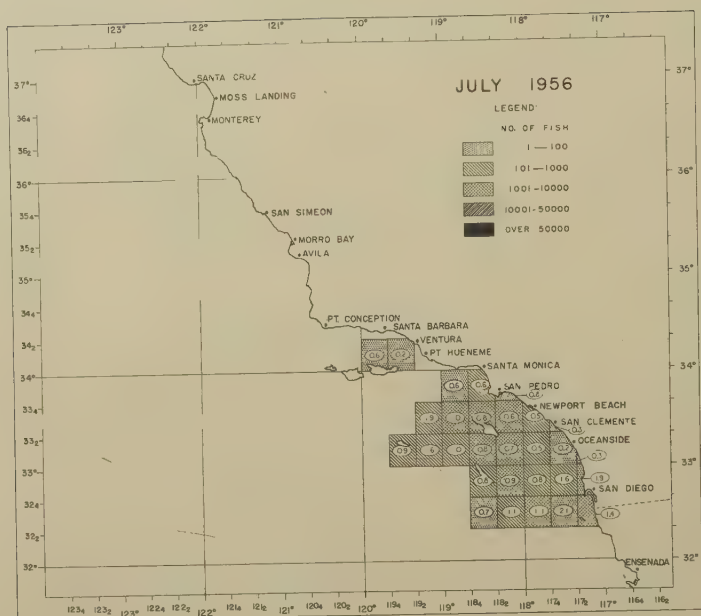


FIGURE 162. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

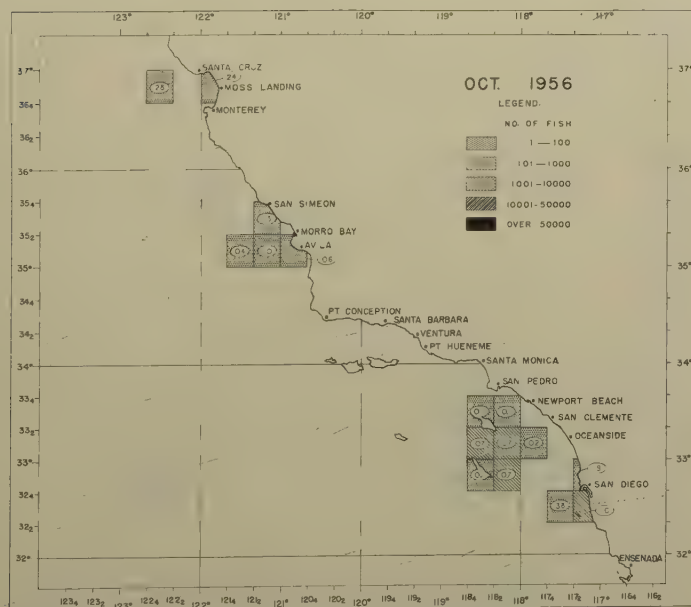
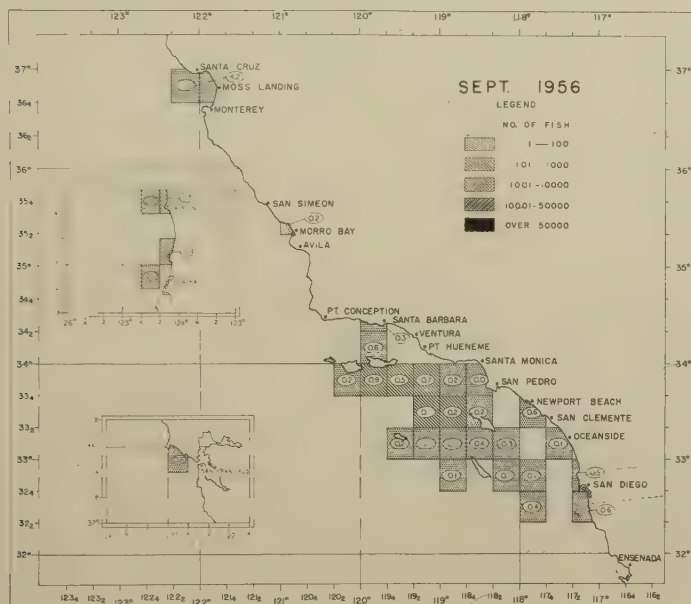


FIGURE 163. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

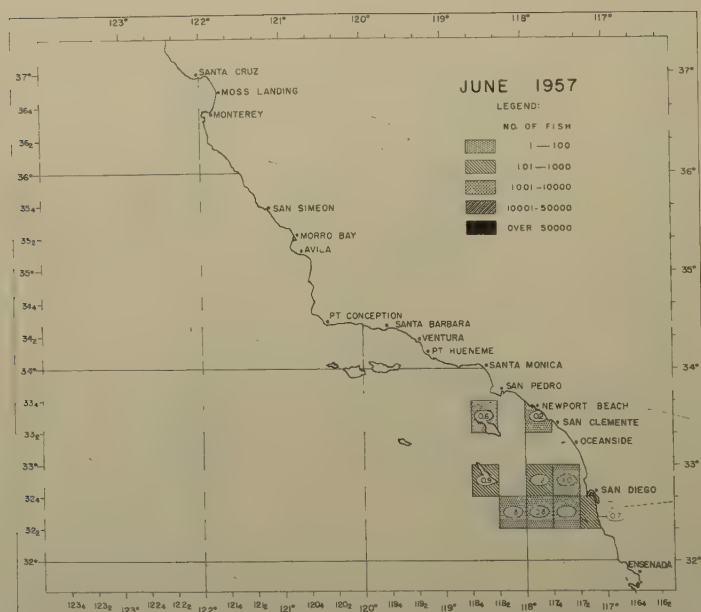
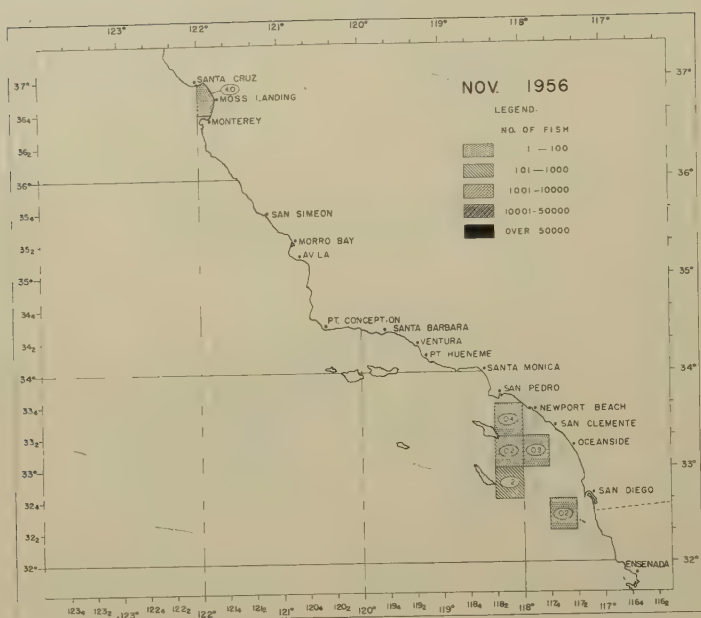


FIGURE 164. Partyboat catch localities and average number of albacore caught per angle day by 20-minute squares. Appendix H.

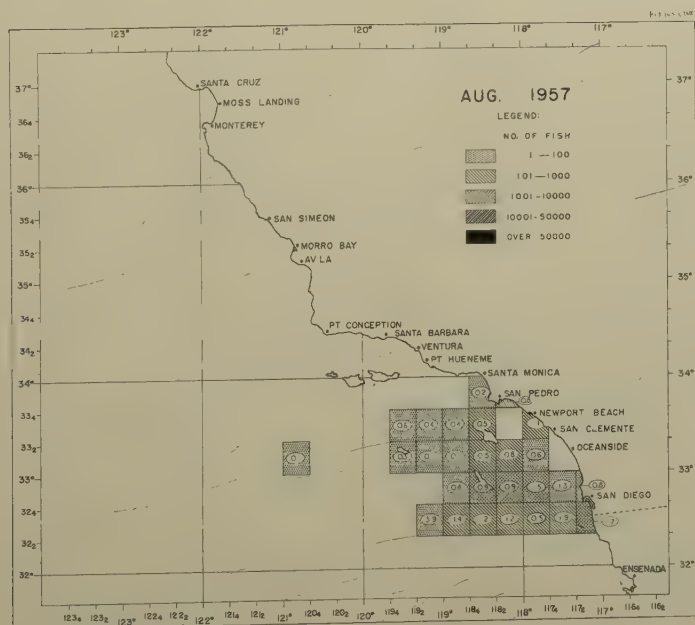
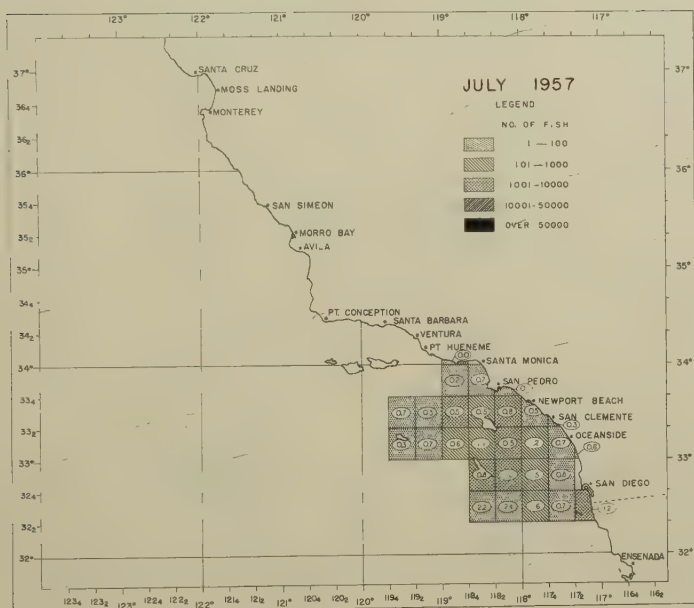


FIGURE 165. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

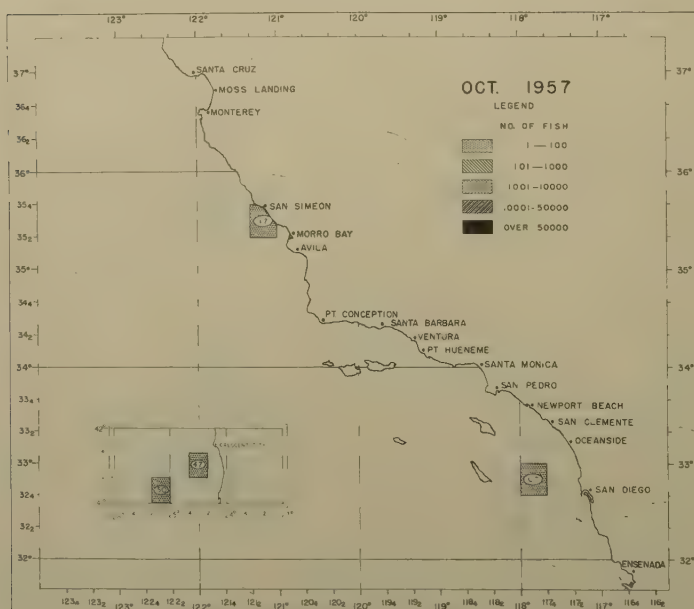
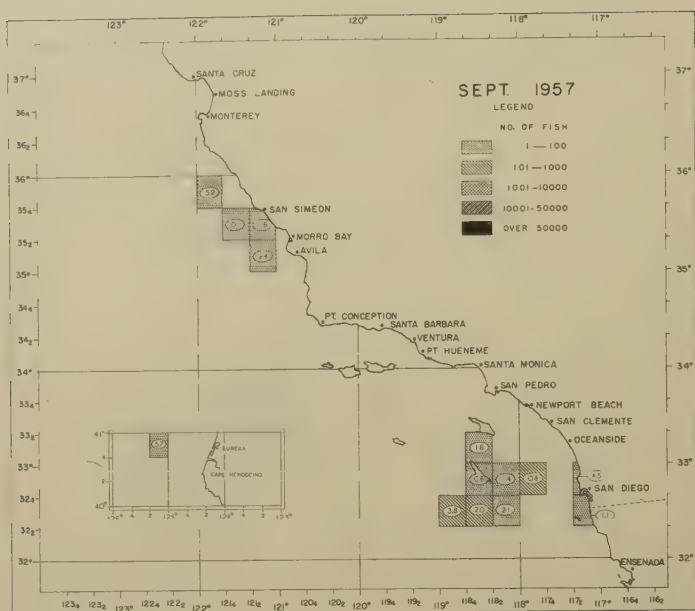


FIGURE 166. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

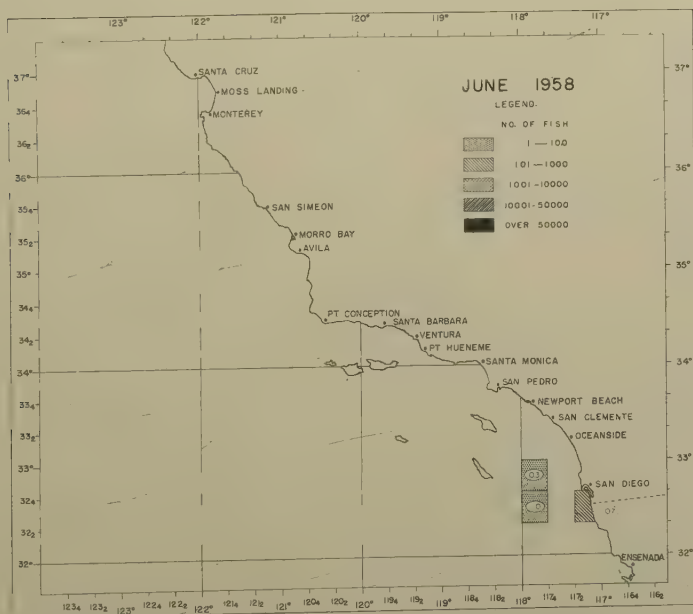
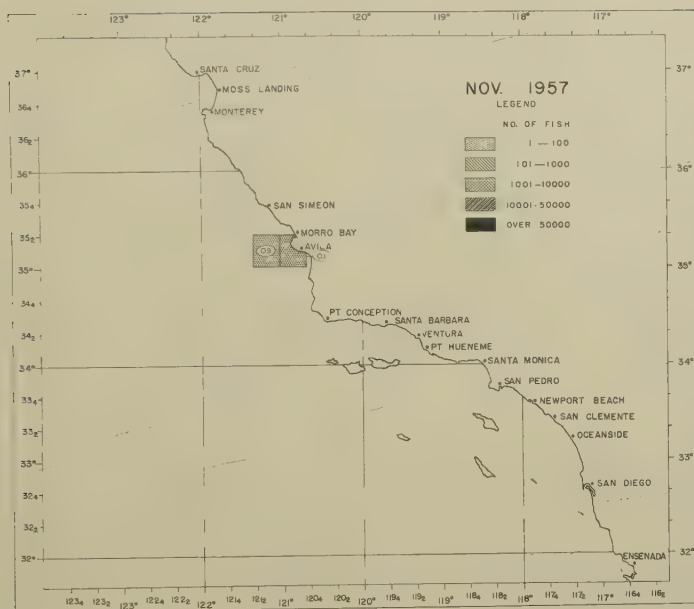


FIGURE 167. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

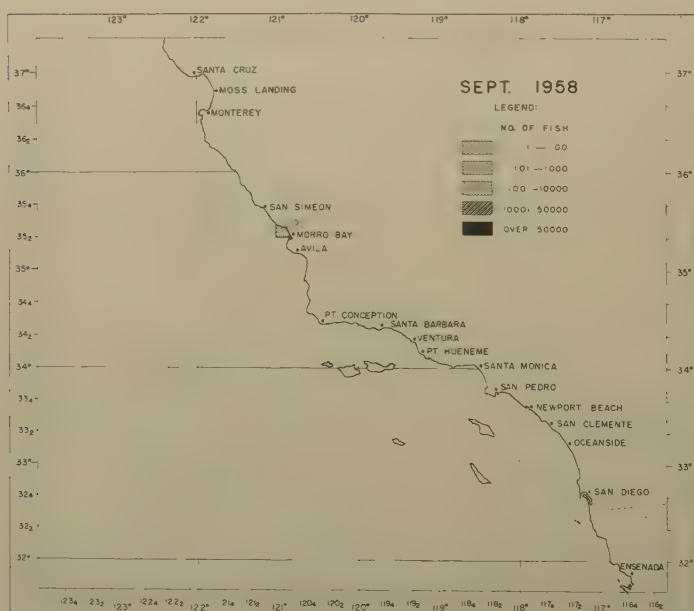
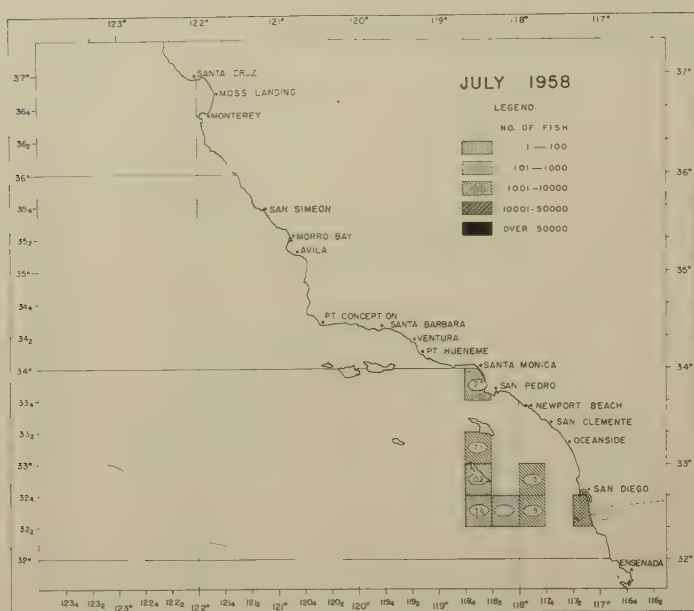


FIGURE 168. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

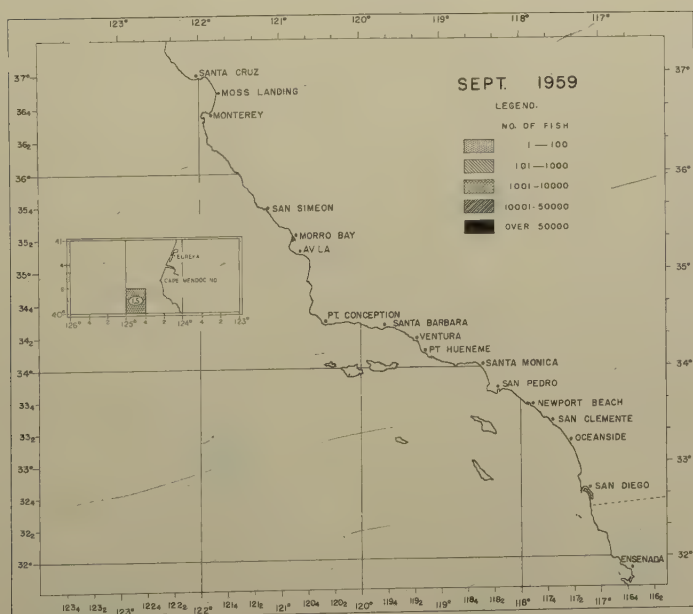
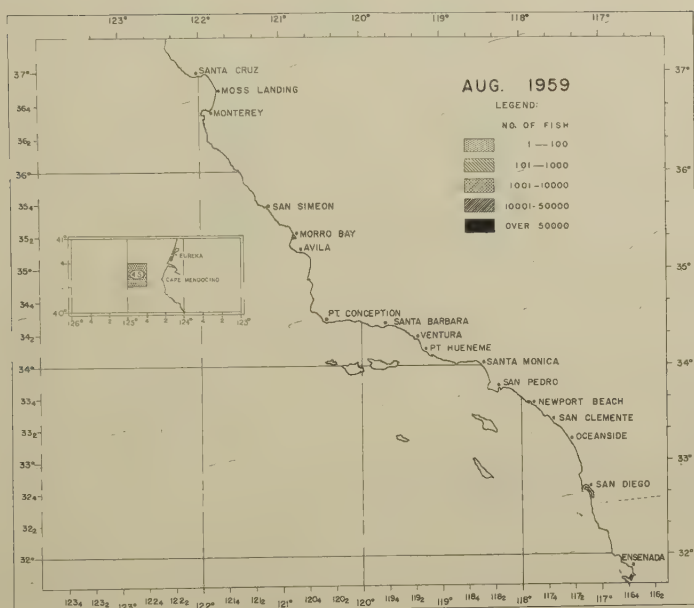


FIGURE 169. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

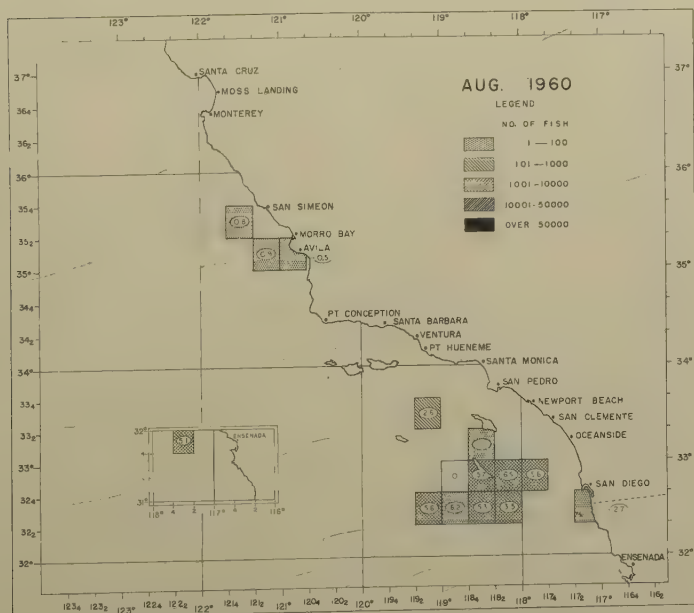
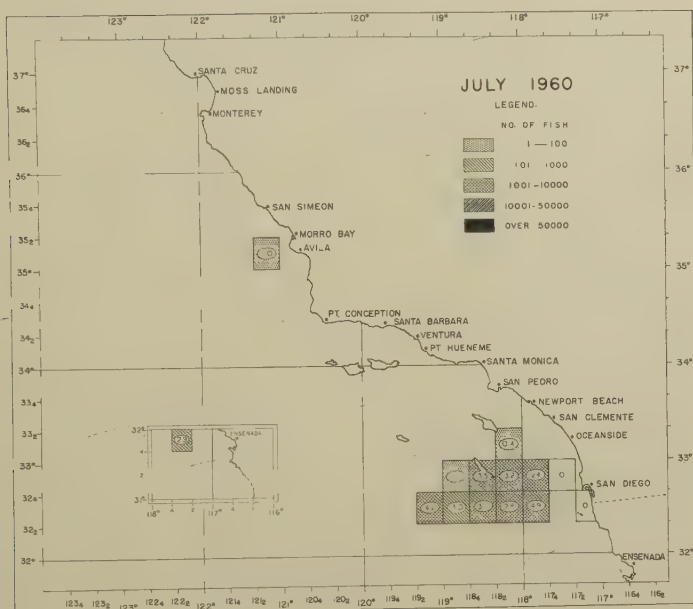


FIGURE 171. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

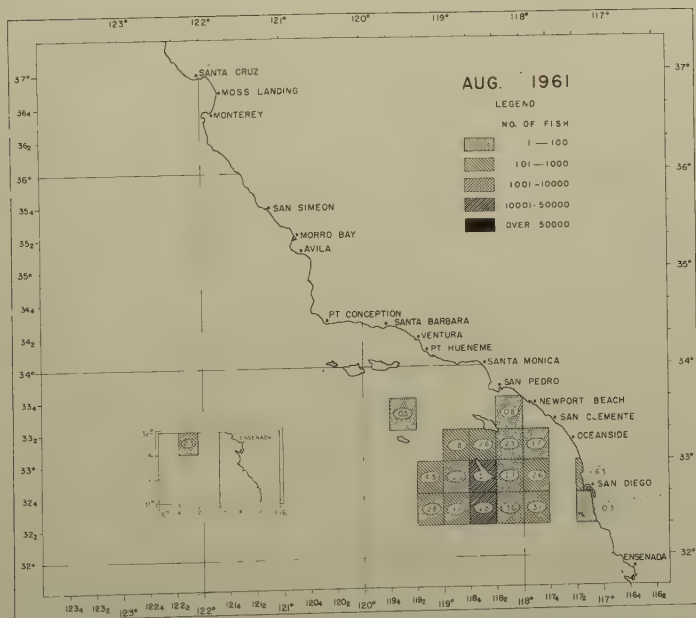
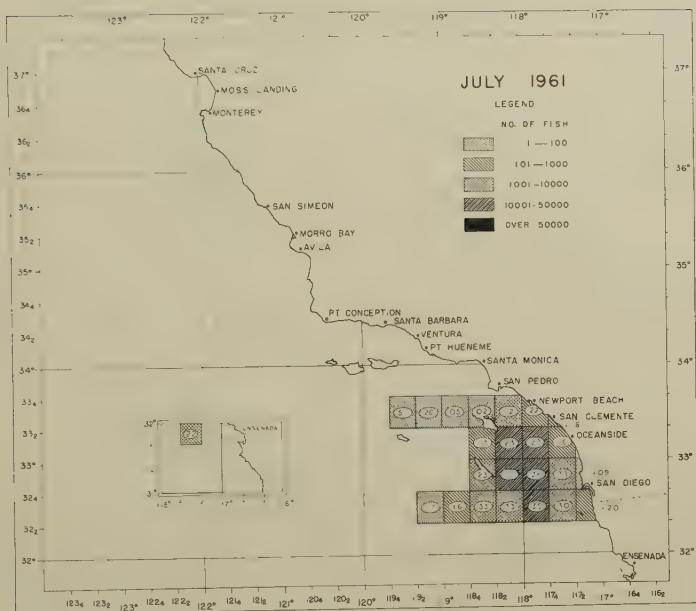


FIGURE 173. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

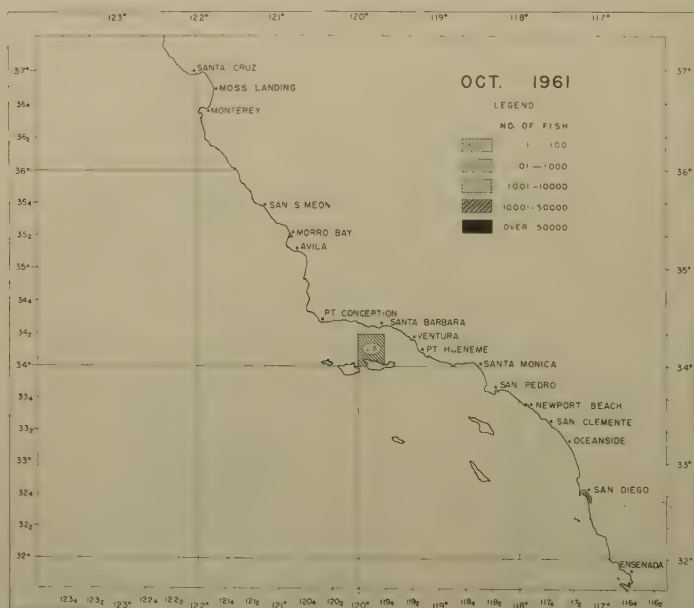
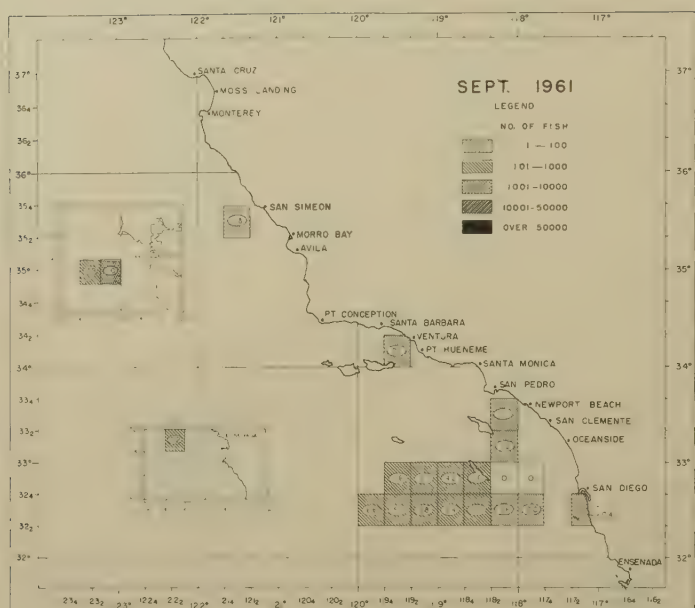


FIGURE 174. Partyboat catch localities and average number of albacore caught per angler-day by 20-minute squares. Appendix H.

The overall picture shows that number of anglers, total albacore caught, and average catch-per-angler-day reached a peak in 1952 (Figure 175). Since then, the total anglers has varied between a high of nearly 89,000 in 1956 to a low of only 20 in 1959. The seasonal catch-effort figures likewise fluctuated widely, and fishing success ranged from 0.6 fish-per-angler-day in 1953 to an all-time high of 3.3 fish in 1960. The annual catch, which had been below average most of the time since 1952, rose significantly in 1960 and 1961. It ranged from only 39 albacore in 1959 to nearly 185,000 in 1961. Such erratic fluctuations are to be expected in a seasonal fishery dependent upon a species that may or may not run within reach of the sportfishermen.

Partyboat catch information also was used to test conclusions reached from analyzing commercial fishing data obtained since 1950. For example, the logs revealed that south of Pt. Arguello the runs occurred inshore during 1950, 1951, and 1952. This was substantiated by the relatively large number of albacore on our sportfishing grounds (Figures 142-153; Table 8). Offshore migrations were indicated by the logbooks for 1953 and 1954, and partyboats reported few albacore below Pt. Arguello, again substantiating previous conclusions.

In warm-water 1958 and 1959, the main migration took place north and outside the sportfishing area according to our logbook analysis. However, in 1958, the partyboats recorded a high catch-per-angler, indicating an abundant supply of fish inshore. An explanation for this apparent discrepancy was obtained from our research vessel *Alaska* (Cruise 58A-3) and several commercial vessels. These data revealed that the 1958 run missed the sporting grounds almost completely; and partyboat anglers, in reality, were setting their hooks in fish which had

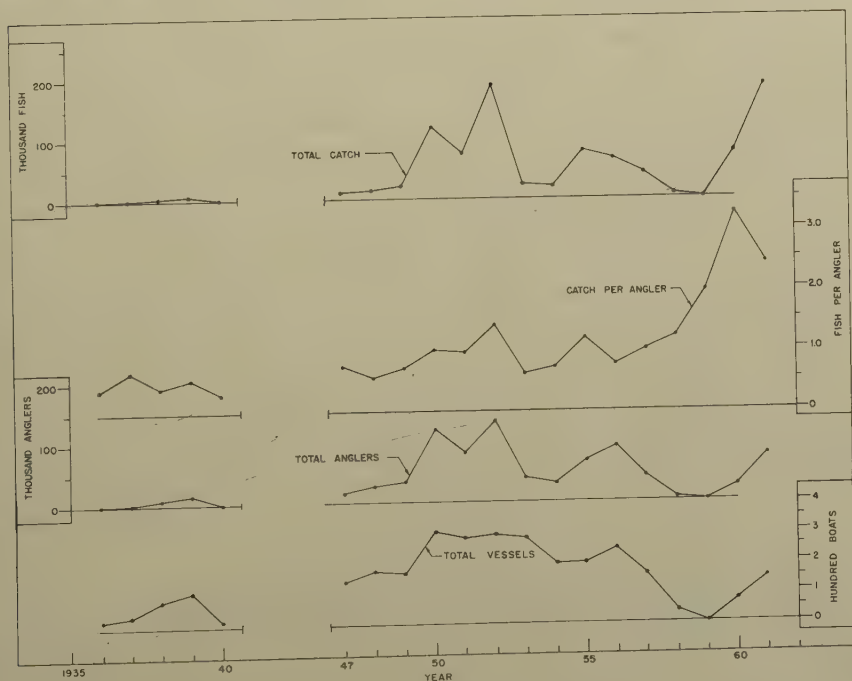


FIGURE 175. Albacore sportcatch statistics from California partyboats.

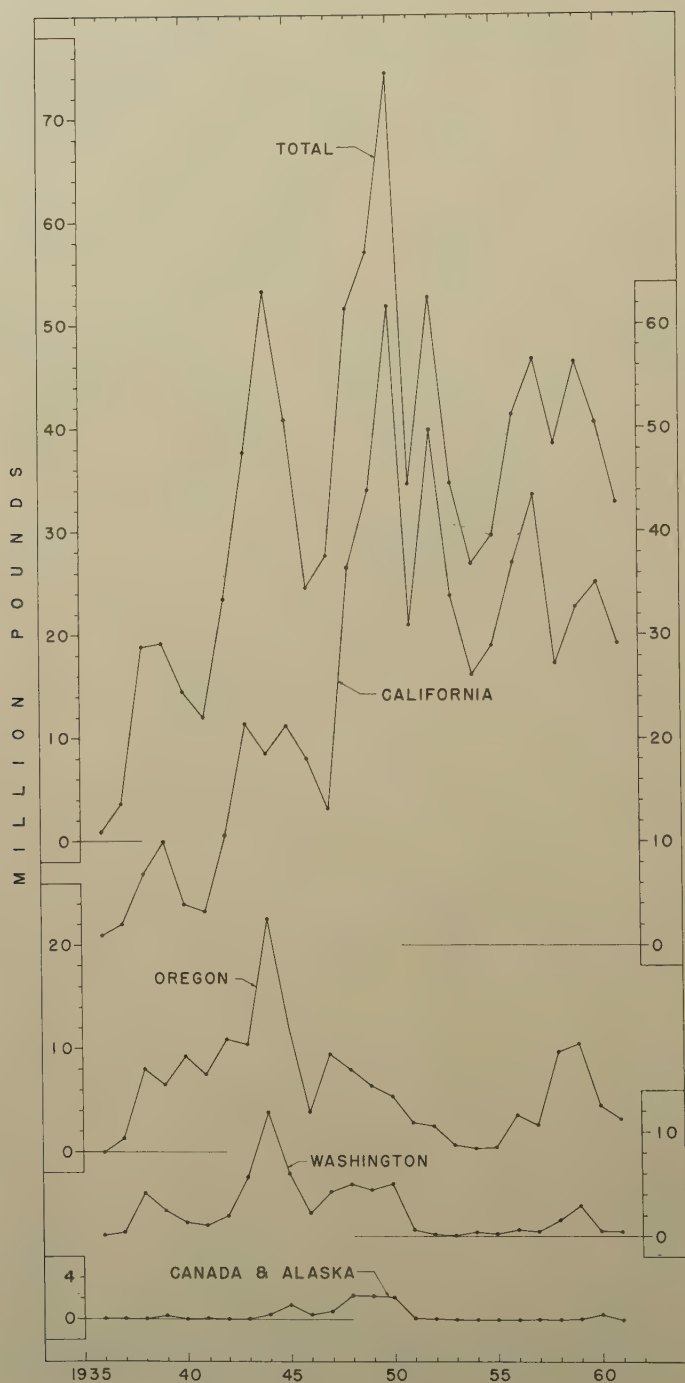


FIGURE 176. Northeastern Pacific albacore landings, 1936-1961.

overwintered off central Baja California and then moved northward and inshore the following summer. Unfortunately, the number overwintering was too small to sustain the sportfishery past mid-July. This brief season saw an 87 percent loss in total anglers from the year 1957 and marked the smallest catch (6,482 fish) since 1940. In 1959, the partyboat catch-per-angler again indicated that large numbers of fish had moved through the inshore grounds (Figure 175). However, the records also showed that the fishing was done by only 20 anglers who enjoyed a short-lived fishery off the central and northern coast, where they reeled in the smallest sportcatch on record—39 albacore for the season. This time no overwintering fish were available to provide even a short season, and the sportfishery failed. Analysis of commercial fishing logbooks for 1960 and 1961 revealed that albacore migrations occurred farther south and closer to shore than during the previous two seasons; the sportcatch improved significantly, thus, again verifying the analysis.

Because most partyboat captains operated within a day's travel from port, albacore angling success was dependent upon inshore migrations. During the 15 seasons 1947–1961, minor advances of warm, limiting, sea-surface temperatures along the Baja California coast made it possible for large numbers of albacore (1 fish per angler-day) to travel through the Channel Islands area nearly half the time.

CONDITION OF THE RESOURCE

The condition of the albacore resource cannot be estimated satisfactorily until equivalent catch data from throughout its geographical range have been assembled and analyzed. Our studies revealed, however, that the segment migrating through California fishing grounds, which provided most of the Northeastern Pacific harvest (Figure 176), has held its own successfully each season against the combined efforts of more than 1,000 sport and commercial fishing vessels. On the average, during the 12 years 1950–1961, the commercial fleet exerted a fishing pressure of nearly 35,000 days (96 boat-years), resulting in a seasonal harvest of 2.5 million albacore. At the same time, the partyboat fleet contributed an average pressure of more than 58,000 angler-days, resulting in a seasonal catch exceeding 73,000 albacore.

Throughout this period, the trend in number of albacore in the run has been slightly upward. If the size of the California migration is any indicator of total numbers in the population, the resource would appear to be in good condition. It is important to note that in 1961, 13-pounders (age II), for years the backbone of a multimillion dollar industry, failed to enter the fishing grounds in their usual numbers. This could happen again and we may not be as fortunate, for next time exceptional quantities of larger fish may not be present to make up for a missing year-class, and the fishery would decline drastically without forewarning.

SUMMARY

In the north Pacific Ocean, albacore are an international resource harvested by Japanese, Hawaiian, and North American fisheries; for this study, we assumed there is one population in the area.

Albacore rank among California's most important species, in terms of recreation and monetary value. Our sport and commercial fisheries depend on a seasonal migration that fluctuates in size and is influenced by changing ocean temperatures. We examined historical records of both fisheries and used sea temperatures in developing hypotheses to explain past events and thus help predict the future.

The Commercial Fishery

For a critical résumé, the records were divided into four periods, depending upon annual magnitude of the landings.

Period I (1916–1925):

During these 10 years, fishing was limited almost exclusively to the California Channel Islands area; and the catch, which was dominated by fish weighing 20 pounds or more, averaged 17.4 million pounds. It was a period of cool sea temperatures, although twice interrupted by unusually warm years (1918 and 1923). During these, albacore ran offshore beyond reach of the small, one-day fishing boats.

Period II (1926–1941):

Abnormal ocean heating in 1926 "pushed" the migrating albacore north of Point Conception, where they found satisfactory conditions each year despite intermittent cooling. Southern California fishing grounds failed, averaging only 2.4 million pounds. Captains gradually increased the duration of their trips, and fishing finally spread into central and northern California—more than a decade after the migration had shifted there.

Period III (1942–1947):

This is the "transition period." Its more important characteristics include relatively cool sea temperatures; a gradual return of the albacore run to the south; a marked improvement in the fisherman's capability to locate and harvest the schools, resulting in the fishery spreading into waters off central Baja California; an increased catch averaging 17.2 million pounds annually; and an end to the dominance of large fish (> 20 pounds) in the landings.

Period IV (1948–1961):

Year 1948 ushered a 9-year, cold-water era into California's marine environment. Incoming albacore schools entered the fishing grounds off central Baja California and, depending upon sea temperatures, swung upcoast either inshore or off.

Warm seas in 1957 ended the cool era and again displaced the albacore run northward, eliminating the productive Baja California fishing grounds that had developed below Guadalupe Island. Increased warming in 1958 caused a drastic decline in the entire Baja California fishery, and abnormal heating in 1959 resulted in complete failure. Meanwhile, fishing to the north improved greatly as fishermen stayed with the schools. The sea cooled in 1960 and 1961, and landings north of the state declined while fishing off Baja California, between the Mexican border and Guadalupe Island, increased markedly.

The commercial fishery matured during this period; the location of the run had no important effect on the size of the catch, and landings

averaged nearly 37 million pounds—more than double any preceding period. Many 13-pound albacore failed to migrate into the fishing grounds in 1961. Fortunately, unprecedented numbers of larger fish moved in and averted a drastic decline in production.

The Sportfishery

Deep-sea angling from partyboats began during the early 1900's in the southern California Channel Islands area, and because of increasing popularity it soon entered the realm of big business. The number of partyboats operating statewide reached a peak of 612 in 1954, and some 200 of these took paying passengers out deep-sea angling for albacore.

Partyboats fishing albacore increased to a high of 304 in 1950 and averaged well over 200 during the post-war years 1947–1957. From 1958 through 1961, the number varied from only 3 boats in 1959 to 149 in 1961. The total anglers attained a record of more than 132,000 in 1952, and a low of 20 in 1959. At the same time, their albacore catch ranged from over 187,000 to only 39.

Catch Analysis

Both sport and commercial fishery statistics have been presented, along with estimates of the magnitude of the annual migration and some insight into albacore behavior. When our data are pooled with similar information in an international exchange, we will be able to determine the ocean-wide harvest and to estimate the relative size of the north Pacific population.

Sales receipts and fishermen's logs were utilized in discussing historical trends in the commercial fishery. A catch-per-day fishing index showed that although the migration size was fairly consistent for 12 years, it was relatively small in 1951 and 1954 and large in 1959 and 1960. The result, overall, was a slight upward trend, implying no decrease in size of the runs. The index also was used to examine relationships between albacore catches and the environment. We found that individuals in a migration distributed themselves by size within preferred temperatures and as a result, each run (as a unit) became temperature-oriented according to its size composition. Fishing success in various temperature categories depended upon both the size composition of the run and its magnitude.

A plot of the abundance index with 58° and 66° F sea-surface isotherms showed that the location of certain temperatures, and the rate at which they progress northward along the coast each season, affects the albacore migration. In addition, the records show that most schools traveled upcoast as the warm water advanced; fewer inhabited seas cooler than 58° F or warmer than 66° F, although they seemed more tolerant of the warmer extremes; and, during warm seasons, larger numbers of albacore entered the northern grounds, traveled farther upcoast, and appeared at greater distances offshore than during cool ones.

Catch records from California's partyboat fleet were summed by 20-minute squares and used in discussing historical sportfishing trends for the period 1936 through 1961. They revealed that the number of anglers, total albacore caught, and catch-per-angler-day peaked in 1952. Since then, the anglers have varied from 89,000 in 1956 to only 20 in

1959. The catch-per-effort figures also show large seasonal changes, ranging from 0.6 fish-per-angler-day in 1953 to a high of 3.3 in 1960. The annual catch, which was below average most of the time, varied from 39 albacore in 1959 to nearly 185,000 in 1961. Such fluctuations are to be expected in a seasonal fishery dependent upon a species that may or may not migrate within range of the anglers.

Partyboat records supported conclusions reached from analyzing the commercial fishery and also demonstrated that successful angling depended upon good inshore runs. These took place when warm sea temperatures advanced very slowly along the Baja California coast, permitting the schools to approach reasonably close to shore. Such events occurred about half the time during the period 1950-1961.

Condition of the Resource

We cannot estimate satisfactorily the condition of the albacore resource without equivalent catch data from throughout its geographical range. However, during the 12 years 1950-1961, the California migration has held its own against an annual pressure of more than 1,000 sport and commercial fishing vessels.

In 1961, without forewarning, the fishery's most important size group for 13 years (age II fish averaging 13 lbs.) failed to enter the grounds in their usual numbers; and although an exceptional amount of larger albacore were present to curtail a serious decline in production, the future could be different.

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APPENDICES

General Origin and Pounds of Albacore Imported Into California, 1927-1961

CALIFORNIA'S ALBACORE FISHERY

Year	Japan	Oregon	Washington	Panama	Hawaii	Mexico	Chile	New Hebrides
1927	77,592							
1928	3,724,955				57,453			
1929	5,798,175				43,054			
1930	7,000,142				5,426			
1931	6,933,079							
1932	2,368,801				98,720			
1933	2,750,353				43,612			
1934	4,141,567				25,900			
1935	3,231,265							
1936	1,493,233	11,176						
1937	1,546,939	757,444	419,310*					
1938	1,953,041	2,918,359	2,780,335					
1939	4,076,376	792,766	1,553,790					
1940	1,433,342	1,511,383	131,771					
1941	444,340	484,704	44,235					
1942		435,036	35,470					
1943								
1944		2,217,708	317,839			47,857		
1945		60,901						
1946								
1947		76,951	58,264					
1948	1,141,747					11,896		
1949	114,033	131,621				38,386		
1950	303,238	24,596	21,947			28,639		
1951	17,519,738					1,153		
1952	22,297,455					16,084		
1953	46,061,197						125,619	
1954	38,224,222					4,518		
1955	44,445,965					3,193	302,641	
1956	19,933,126						305,554	
1957	39,234,766						329,261	
1958	27,039,303			433,643				
1959	27,089,048	266,587	669,875	1,596,014			34,028	
1960	28,268,754			6,170,614				1,826,089
1961	26,610,635			3,502,392		91,950		

* This figure exceeds Washington albacore landings by nearly 87,000 pounds (Table 1); apparently these were not included in Washington records before transshipment to California.

APPENDIX B
Average Annual Sea Surface Temperatures at Scripps Pier, La Jolla, 1917-1961

Year	Temperature		Year	Temperature		Year	Temperature	
	°C.	°F.		°C.	°F.		°C.	°F.
1917	16.6	61.9	1932	16.3	61.3	1947	16.9	62.4
1918	17.4	63.3	1933	15.6	60.1	1948	16.0	60.8
1919	16.9	62.4	1934	17.4	63.3	1949	16.5	61.7
1920	16.5	61.7	1935	16.6	61.9	1950	16.4	61.5
1921	16.5	61.7	1936	17.6	63.7	1951	16.6	61.9
1922	16.5	61.7	1937	17.0	62.6	1952	16.3	61.3
1923	17.4	63.3	1938	16.6	61.9	1953	16.3	61.3
1924	17.4	63.3	1939	17.2	63.0	1954	16.8	62.2
1925	16.8	62.2	1940	17.4	63.3	1955	16.5	61.7
1926	18.0	64.4	1941	17.6	63.7	1956	16.4	61.5
1927	16.6	61.9	1942	17.0	62.6	1957	17.4	63.3
1928	16.6	61.9	1943	17.0	62.6	1958	17.8	64.0
1929	17.0	62.6	1944	16.4	61.5	1959	18.4	65.1
1930	17.4	63.3	1945	16.6	61.9	1960	16.6	61.9
1931	18.4	65.1	1946	16.8	62.2	1961	16.5	61.7
45-Year Mean	16.9°C.	62.4°F.						

81	30	4	0	291	625	80	40	145	174	103	300	87	0	23
82	93	3	3	258	402	59	11	110	52	72	272	34	1	21
83	42	0	3	174	270	29	12	69	57	47	262	16	0	32
84	50	1	0	110	178	31	10	55	24	32	201	10	1	30
85	69	1	2	84	95	19	5	49	16	17	96	4	0	19
86	31	1	2	58	56	19	2	49	7	14	101	0	0	22
87	17	0	0	37	55	17	0	43	7	8	53	0	0	17
88	18	0	0	30	42	11	0	59	4	3	26	0	0	19
89	20	1	0	23	47	9	1	38	4	3	12	0	0	15
90	13	0	0	22	52	10	1	21	2	5	15	0	0	19
91	8	0	0	29	47	12	0	34	0	2	10	1	1	9
92	5	0	0	25	34	5	0	28	3	4	8	0	0	4
93	3	0	0	50	80	9	1	21	1	1	5	0	0	4
94	5	1	0	38	6	6	1	4	2	1	8	0	0	3
95	3	1	1	31	31	1	0	6	2	0	3	0	0	0
96	2	0	0	23	23	0	0	2	0	0	4	0	0	1
97	6	1	1	33	1	1	0	0	0	0	10	0	0	1
98	1	1	1	16	16	1	0	0	0	0	7	0	0	0
99	0	1	1	3	18	1	0	0	0	0	14	0	0	0
100	0	0	0	11	9	2	0	1	0	0	7	0	0	0
101	1	1	1	6	16	2	0	0	0	0	8	0	0	0
102	2	0	0	3	14	1	0	0	0	0	8	0	0	0
103	4	4	4	4	6	0	0	0	0	0	7	0	0	0
104	0	0	0	3	6	1	1	1	1	1	8	0	0	0
105	1	1	1	1	8	1	1	1	1	1	5	0	0	0
106	1	0	0	0	6	0	0	0	0	0	10	1	1	0
107	0	0	0	0	0	0	0	0	0	0	3	0	0	0
108	1	0	0	1	2	1	0	0	0	0	9	0	0	0
109	0	0	0	1	1	1	0	0	0	0	5	0	0	0
110	0	0	0	0	2	0	0	0	0	0	3	0	0	0
111	1	0	0	0	0	0	0	0	0	0	0	0	0	0
112	0	0	0	1	1	0	0	0	0	0	3	0	0	0
113	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	0	0	0	0	0	0	0	0	0	0	1	0	0	0
117	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	0	0	0	0	0	0	0	0	0	0	1	0	0	0
119	0	0	0	0	0	0	0	0	0	0	1	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,565	164	111	7,983	10,686	9,658	1,924	5,100	4,329	2,550	4,915	1,401	50	504

APPENDIX C—Continued

ILLUSTRATIONS FROM THE CALIFORNIA COMMERCIAL FISHERY, SEASONS 1917-1961 (Unweighted)—Continued

[illegible]

81	41	2	30	30	162	116	62	37	22	225	133	155	239	348
82	34	2	22	33	178	112	59	29	16	223	126	149	200	254
83	21	3	30	35	134	105	32	15	0	122	110	121	175	162
84	7	3	26	31	123	87	36	6	5	196	65	134	140	81
85	12	0	24	23	111	68	21	5	2	110	51	103	111	30
86	5	1	10	24	99	59	21	3	1	79	42	54	88	21
87	2	0	13	19	93	72	14	9	2	36	36	38	59	7
88	3	0	9	11	64	64	7	3	0	57	30	38	42	7
89	8	0	8	8	60	47	4	1	0	33	23	13	27	4
90	1	0	8	5	65	37	4	0	3	32	25	17	10	4
91	1	2	2	6	44	38	0	0	0	33	15	1	8	5
92	0	0	0	1	34	22	0	0	0	33	15	2	9	1
93	0	0	0	1	31	10	1	1	1	28	15	2	5	5
94	0	0	0	2	14	6	0	0	0	11	16	2	2	1
95	0	0	0	0	13	4	0	0	0	8	6	1	1	1
96	0	0	0	1	14	0	0	0	0	8	6	1	2	0
97	0	0	0	0	4	0	0	0	0	6	4	1	0	0
98	0	0	0	0	4	0	0	0	0	0	2	0	0	0
99	0	0	0	0	2	0	0	0	0	0	3	0	0	0
100	0	0	0	0	2	0	0	0	0	0	1	0	0	0
101	0	0	0	0	0	1	0	0	0	0	1	0	0	0
102	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	0	0	0	0	0	0	0	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
106	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	0	0	0	0	0	0	0	0	0	0	0	0	0	0
113	0	0	0	0	0	0	0	0	0	0	0	0	0	0
114	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0
116	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	0	0	0	0	0	0	0	0	0	0	0	0	0	0
118	0	0	0	0	0	0	0	0	0	0	0	0	0	0
119	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1,131	2,296	2,760	4,711	14,092	7,207	6,347	8,697	3,858	6,982	4,560	15,345	10,621	6,601

APPENDIX D
Albacore Length Frequencies from the California Commercial Fishery, Weighted by the Monthly Catch
Seasons 1951-1961

Fork length (mm)	Calculated pounds ($4.936 \times 10^{-3} L^{3.09}$)	1951		1952		1953		1954		1955	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
440	3.91										
450	4.19										
460	4.47										
470	4.77										
480	5.08										
490	5.40										
500	5.74			195	.006	711	.032	164	.008	249	.009
				585	.000	356	.016	1,461	.075	901	.034
10	6.08			2,890	.089	645	.029	5,385	.276	3,328	.126
20	6.45		.027	6,657	.205	6,314	.284	15,646	.802	7,318	.277
30	6.83	1,145	.057	8,378	.268	15,962	.718	41,965	2.152	11,843	.449
40	7.22	8,438	.420	12,697	.391	31,234	1.405	38,515	1.975	25,942	.984
50	7.62	16,152	.804	13,963	.438	59,779	2.689	43,089	2.210	32,341	1.226
60	8.05	12,938	.644	17,705	.548	64,069	2.882	43,372	2.224	48,661	1.769
70	8.48	14,023	.698	20,979	.654	71,605	3.221	31,618	1.621	38,603	1.464
80	8.94	17,719	.882	44,358	1.366	54,554	2.454	33,518	1.719	45,052	1.720
90	9.41	36,825	1.833	57,185	1.761	51,131	2.300	45,052	2.310	71,740	2.795
100	9.89	46,930	2.336	96,186	2.962	61,925	2.889	51,076	2.619	139,641	5.295
110	10.39	75,417	3.754	130,348	4.014	63,513	2.887	45,263	2.321	279,551	10.569
120	10.91	97,496	4.853	167,562	5.100	113,956	5.216	55,737	2.921	413,556	15.745
130	11.44	135,767	6.758	236,600	7.286	162,151	7.294	86,200	4.390	477,718	18.113
140	12.00	172,830	8.603	269,789	8.308	195,920	8.965	130,632	6.680	405,035	15.357
150	12.56	172,411	8.582	257,350	7.925	253,821	10.518	177,133	9.083	251,773	9.546
160	13.15	111,258	5.538	211,108	6.501	195,920	8.813	202,088	10.363	123,730	4.692
170	13.75	90,746	4.517	172,237	5.304	161,640	7.271	238,216	12.216	66,369	2.479
180	14.38	64,971	3.234	151,487	4.665	93,792	4.219	194,011	9.949	48,179	1.827
190	15.02	58,984	2.936	111,058	3.420	49,197	2.213	110,252	5.641	31,841	1.207
200	15.68	57,236	2.849	95,439	2.939	18,563	.835	70,264	3.603	13,721	.520
210	16.36	67,080	3.339	91,889	2.830	14,606	.657	42,170	2.162	16,497	.625
220	17.05	85,442	4.253	112,682	3.470	11,760	.529	32,468	1.665	11,247	.426
230	17.77	98,561	4.906	108,883	3.353	7,470	.336	24,182	1.240	6,168	.234
240	18.51	99,143	4.935	84,171	2.592	13,272	.597	16,264	.834	5,387	.204
250	19.27	110,554	5.503	111,416	3.431	15,117	.680	12,776	.655	9,414	.357
260	19.97	50,992	4.028	120,800	3.720	24,254	1.091	16,154	.828	7,637	.290
270	20.84	72,886	3.628	93,815	2.889	25,454	.824	16,078	.824	7,272	.272
280	21.66	44,519	2.210	87,548	2.698	30,767	1.384	16,881	.866	18,866	.715
290	22.50	28,226	1.405	54,555	1.680	31,701	1.426	13,800	.708	11,501	.436

800	23.36	24,570	1.222	50,626	1.559	32,012	1.440	11,414	.585	11,100	.421
10	24.25	11,582	.573	36,013	1.109	37,992	1.709	13,322	.683	12,371	.469
20	25.15	13,621	.878	38,741	1.193	35,969	1.618	14,875	.763	11,834	.449
30	26.08	15,208	.757	31,399	.968	35,347	1.590	9,422	.483	6,003	.228
40	27.03	12,275	.611	24,420	.752	27,833	1.282	11,664	.567	2,085	.079
50	28.00	9,322	.464	20,880	.613	22,561	1.015	6,238	.320	2,692	.102
60	29.00	6,744	.485	20,945	.645	19,341	.870	7,093	.364	4,064	.154
70	30.02	7,996	.398	17,555	.540	23,565	1.080	4,021	.206	969	.037
80	31.06	4,661	.232	9,480	.291	20,049	.941	2,149	.110	326	.012
90	32.13	3,315	.165	8,638	.266	13,650	.677	1,297	.067	326	.012
100	33.22	2,109	.105	7,729	.290	12,271	.552	370	.019	0	.000
10	34.34	2,150	.107	7,729	.238	12,138	.546	206	.000	0	.000
20	35.48	382	.019	3,410	.105	7,092	.319	206	.011	25	.001
30	36.64	121	.006	2,825	.087	3,135	.141	378	.019		
40	37.83	824	.041	1,039	.032	1,200	.061	432	.022		
50	39.05	0	.000	1,137	.035	1,890	.085				
60	40.29	5,485	.273	1,494	.046	1,396	.061				
70	41.56			292	.009	0	.000				
80	42.85			422	.013	0	.000				
90	44.17			162	.005	0	.000				
1000	45.52			162	.005	0	.000				
10	46.90										
20	48.28					289	.013				
Total		2,008,985		3,247,322		2,223,077		1,950,111		2,637,429	

800	23.36	27,734	1.089	123,524	4.698	65,602	3.861	22,213	.868	84,061	3.432	136,935	8.929
100	24.25	11,613	.456	103,887	3.951	59,903	3.326	25,334	.992	67,570	2.759	92,404	6.025
200	25.15	9,990	.392	81,849	3.113	58,023	3.415	27,337	1.068	58,092	2.372	65,704	4.284
300	26.08	2,599	.102	58,038	2.207	51,945	3.057	20,787	.812	49,645	2.027	47,506	3.098
400	27.03	2,164	.085	49,241	1.873	27,156	1.598	22,456	.878	44,764	1.827	22,653	1.477
500	28.00	1,842	.072	34,901	1.327	22,220	1.308	17,424	.681	34,160	1.395	7,958	.519
600	29.00	1,889	.007	24,479	.931	21,347	1.286	6,255	.244	28,363	1.395	6,293	.417
700	30.02	379	.015	19,406	.738	16,708	.983	4,521	.177	18,694	1.158	1,807	.118
800	31.06	0	.000	16,546	.629	15,360	.904	3,273	.128	14,529	.593	1,871	.122
900	32.13	0	.000	8,660	.329	10,876	.640	1,456	.057	8,995	.367	808	.055
1000	33.22	2,031	.080	8,098	.308	12,024	.708	988	.039	3,620	.148	2,301	.150
10	34.34	---	---	9,906	.377	7,450	.438	60	.002	2,793	.114	1,325	.080
20	35.48	---	---	10,306	.382	10,151	.597	583	.023	3,207	.131	241	.090
30	36.64	---	---	8,156	.310	6,658	.392	457	.018	1,831	.075	332	.022
40	37.83	---	---	4,000	.152	7,380	.434	457	.018	827	.034	1,132	.074
50	39.05	---	---	2,542	.097	2,165	.127	60	.002	1,240	.051	332	.022
60	40.29	---	---	2,370	.090	1,323	.078	0	.000	618	.025	241	.016
70	41.56	---	---	2,115	.080	2,120	.125	291	.011	---	---	---	---
80	42.85	---	---	---	---	2,093	.133	291	.011	---	---	---	---
90	44.17	---	---	---	---	27	.002	---	---	---	---	---	---
1000	45.52	---	---	---	---	1,422	.084	---	---	---	---	---	---
10	46.90	---	---	---	---	693	.041	---	---	---	---	---	---
20	48.28	---	---	---	---	---	---	---	---	---	---	---	---
Total	---	2,545,677	---	2,629,517	---	1,699,037	---	2,558,640	---	2,449,486	---	1,533,672	---

APPENDIX E
 California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
 June-November, 1951, in Pounds

Area	June	July	August	September	October	November	Total
26-115			9,877	81,302			91,179
27-115			486,960				486,960
116		1,198,046	1,123,098				2,321,144
28-115	421,149	1,906,423	1,592,125	249,990			4,169,597
116		375,848	417,983	1,098,530			1,892,361
118	19,686	182,994	64,917	81,194			348,791
119			222,150	40,244			262,394
120			642,797	528,491			1,171,288
29-115	25,770	334,466	72,102	686,594	356,834		1,475,766
116	95,422	582,931	922,998	306,225			1,908,576
117		104,132	170,421	12,637			287,190
118	19,686	182,994	64,917	40,244			267,597
119			44,689	33,112			84,933
120			654,797	213,018			687,909
121							213,018
30-116	531,287	3,388,723	1,534,076	12,583			5,466,669
117		233,309	190,001	234,984			423,310
118			30,400				265,384
31-116							180,073
117	14,089	117,842	55,732	1,410			108,994
118		964	108,030				196,250
119		7,832	188,118	89,275			89,275
121							662,678
32-117		259,917	75,708	327,053			1,174,984
118	98,099	925,584	151,301				71,483
119			71,483				
33-117		3,430	61,448	98,089			162,967
118		622,402	164,187	143,350			929,939
119		18,594					18,594
120			1,051				1,051

34-119.....	169,430	8,991	-----	-----	-----	178,421
120.....	18,967	2,311	-----	-----	-----	27,298
121.....	23,179	-----	-----	6,020	-----	23,179
122.....	40,026	209,409	-----	-----	-----	249,435
123.....	-----	779,312	-----	-----	-----	779,312
35-121.....	-----	1,181	-----	38,671	-----	39,852
122.....	-----	889,509	-----	348,775	-----	1,238,284
36-121.....	-----	-----	-----	28,149	-----	28,149
122.....	-----	1,181	-----	218,198	258,258	1,141,707
123.....	-----	83,648	-----	-----	-----	83,648
124.....	-----	18,940	-----	420,884	-----	439,824
37-122.....	-----	18,940	-----	-----	258,258	428,138
38-124.....	-----	-----	-----	789,482	-----	789,482
Total.....	1,225,188	11,136,088	-----	6,128,414	516,516	30,876,083
				1,171,844		

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June–December, 1952, in Pounds

Area	June	July	August	September	October	November	December	Total
26-114		459,505	596,893					1,056,398
115		621,892	489,349					1,111,241
27-114		27,217	41,004					68,221
115		203,177	322,192					525,369
116	93,966	449,778	86,742					630,485
118			810,260					810,260
119			2,479,386	48,295				2,527,681
120			862,531	43,990				906,521
28-115		1,940,572	110,607	4,649				2,403,081
116	347,163	3,206,521	147,897					3,694,141
117	339,723	682,320	84,996					824,174
118	56,898	11,005	2,445,486	458,632				2,928,838
119	13,715	50,823	1,962,716	93,261				2,106,809
120		15,566	251,696					267,262
121			100,585					100,585
29-115		408,777	437,530	25,644				882,536
116	10,585	864,739	1,377,190	25,644				2,278,158
117	153,505	1,276,682	121,599					1,551,786
118	13,715	43,796	998,929	447,921				1,504,361
119			97,472	27,578				125,050
120		15,566	147,997					163,563
121			162,357					162,357
30-115								31,858
116	31,858	425,732	644,231	495,434				1,640,110
117	74,713	369,680	200,175	44,892				656,018
118	41,271	85,598	1,115	6,899				103,217
119	9,605		38,349					38,349
31-116		102,097	792,230	1,115,622				2,010,949
117		952,962	665,145	1,218,719				2,836,826
118		241,150	63,897	142,141	131,717			578,905

32-117	309,819	420,905	486,731	406,112	1,217,455
118	515,600	1,048,770	421,309	---	2,391,791
119	12,421	108,752	79,416	---	200,589
33-117	689	7,217	---	---	7,906
118	28,877	191,703	25,384	663,585	909,549
119	9,546	1,153,585	257,089	---	1,420,229
120	---	---	---	210,526	210,526
121	---	---	---	207,419	212,921
122	---	---	---	44,191	44,191
34-120	---	---	---	2,530,892	2,876,598
121	---	---	---	474,759	762,905
35-121	---	---	---	288,146	---
36-122	---	---	---	169,089	4,559,597
---	---	---	83,098	---	464,175
---	---	---	5,295,259	---	---
Total	13,332,107	19,472,538	---	8,854,662	49,803,524
---	---	---	---	1,646,154	---
---	---	---	---	5,502	---

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June-November, 1953, in Pounds

Area	June	July	August	September	October	November	Total
26-116			228,101				228,101
120			143,640				143,640
121		88,842	204,880				293,722
122			90,738				90,738
27-116		323,998					323,998
117		1,855,435					1,855,435
118		320,718					320,718
119		2,004,511	1,100,579	27,719			3,132,809
120		78,539	1,539,480	43,181			1,661,200
124			236,438				236,438
28-116	17,877	12,366					30,243
117		155,323					155,323
118		254,837	124,665	18,496			397,998
119		1,297,456	888,402	45,099			2,230,957
120	85,745	384,335	763,959	64,273			1,298,312
121			612,550	94,636			707,186
124				37,768			37,768
29-115	30,895	5,282					36,177
116	48,772	17,648					66,420
117	372,332	1,318,600	84,990				1,775,922
118		76,399	128,968				205,367
119			800,119	47,139			847,258
120	85,745	384,335	2,250,259	250,802			2,971,141
121			174,322	5,900			180,222
30-117	139,340	134,118	402,895				676,353
119			99,325	39,100			138,425
120			562,911	9,180			572,091
121			540,530	45,462			584,991
122			230,523	6,400			237,023
31-116		134,949	139,587				274,536
117		139,508	575,484	31,449			746,441
118			227,879				227,879
122			214,054				214,054
123			85,506	32,028			117,534
124				32,028			32,028

32-117	3,640	214,351	5,343	5,343	223,334
118	40,846	811,097	314,593	314,593	1,166,536
119		93,616			93,616
120			86,030	86,030	86,030
121			126,205	126,205	158,357
122			139,221	139,221	160,127
123					
33-118			5,343	5,343	183,972
119			11,033	11,033	63,197
120			83,729	83,729	158,162
121					
34-120			148,319	148,319	176,513
121		3,003	135,518	135,518	182,914
122					137,308
123			39,684	39,684	595,682
124					71,233
125					66,893
35-121					11,572
122			73,037	73,037	1,154,250
123			53,124	53,124	1,144,642
124			8,087	8,087	908,236
125					255,611
36-122					56,225
123			58,063	58,063	994,546
124			17,483	17,483	1,593,745
125					111,252
126					126,137
127					27,287
37-123					473,491
124			11,091	11,091	205,893
125			12,304	12,304	179,772
126					33,525
127					30,900
38-125					27,287
126					7,472
127					6,165
42-126					6,165
127					6,165
Total	886,038	10,227,249	13,788,490	7,426,940	33,835,905

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June–December, 1954, in Numbers and Pounds

Area	June		July		August		September	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
25-122			640	8,487	422	5,598		
26-118			24,680	355,891	2,957	42,362		
120			7,874	104,689	1,728	22,979		
122			1,111	14,772	70	931		
27-117			404	5,375	4,234	56,293		
118			14,691	209,096	527	7,004		
119	7,734	118,512	101,773	1,419,013	9,855	131,061		
120			46,590	666,988	7,765	98,473		
121			2,223	43,588	9,118	141,625		
28-115	835	12,822	9,787	141,508				
116			2,122	25,947	2,091	25,602		
117			9,895	140,005	4,146	50,724		
118			8,029	112,132				
119	3,193	48,958	93,218	1,296,046	8,058	107,046		
120			23,535	317,489	5,112	73,041		
121			2,162	28,729	269	3,364		
122					4,585	60,966		
29-116	2,407	30,262	26,176	386,682				
117			64,826	926,852	1,060	14,101		
118	1,769	27,090	14,806	210,517				
119	91	1,109	36,940	486,048	9,697	156,106		
120			25,361	344,958	50,823	50,823		
121			539	7,180	9,627	120,877		
122					1,171	24,524		
30-116			896	11,384				
117	119	1,825	8,198	113,251	2,342	33,900		
118			3,435	48,734	21,573	328,492		
119			2,075	29,921	40,347	482,098	7,175	140,432
120					20,572	245,953	1,940	55,678
121			4,345	57,814	1,171	15,717		
122								
31-116			3,476	42,342				
117	1,797	27,525	20,288	292,984	18	457		
118			9,552	135,203	410	4,626		
119					23,113	278,770	3,819	50,819
120			4,048	56,013	118,207	1,485,896	828	11,273
121			2,001	26,593			5,012	63,640
122					10,289	112,808		

32-117	1,425	18,661	5,402	77,678	8,333	107,444	25	350
118	119	1,825	51,469	727,200	11,901	146,801	4,555	66,662
119	189	2,831	13,898	282,611	41,723	514,481	20,916	282,955
120			9,060	119,394	37,624	446,553	11,562	144,885
121			3,240	43,053	1,774	21,796	1,869	29,025
122					1,124	14,960		
123								
33-117					1,476	19,822		
118			9,026	127,604	1,077	14,318		
119	926	14,197	23,380	331,298	12,186	171,625	1,787	23,830
120					12,801	147,475	35,814	428,322
121			1,185	12,441	22,393	265,290	127,555	1,635,242
122					14,476	174,605	34,991	468,724
123					2,928	28,665	457	6,809
34-120							487	8,017
121					12,602	153,448	39,973	516,181
122					4,843	60,409	27,720	342,305
123					9,434	103,351	1,341	20,413
124								
35-121							1,219	14,005
122					4,830	54,196	38,713	501,476
123					88	1,025	26,562	319,212
36-122								
123					4,638	63,917	58,400	742,870
124					20,032	252,003	53,119	694,597
37-122							2,437	30,985
123					64	820	91	1,137
124							15,355	184,310
125							9,328	120,228
126							178	2,305
38-123							371	4,920
124							1,701	21,845
39-124								
125					4,550	59,033	208	2,737
126					1,370	17,778	950	11,806
40-124								
125					3,847	44,926	376	4,885
126					82	1,066	914	11,709
41-124								
125							25	371
126							152	1,676
42-125								
126							157	1,833
							147	1,843
Total	20,604	305,677	698,365	9,771,050	568,332	7,171,315	538,299	6,968,313

[illegible]

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1955—January, 1956, in Numbers and Pounds

Area	June		July		August		September	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
25-115					9	103		
26-114								
115			4,293	44,911	25,254	310,306		
116			689	7,232	4,190	48,234		
118			1,829	19,561				
27-114					4,092	43,064		
115			5,073	48,001				
116			6,569	67,192	60,770	653,339		
117			52,383	550,141	15,007	166,113		
118			9,216	96,310				
119			1,037	10,854				
			1,260	12,939				
28-115	379	3,866	24,382	254,702	22,317	235,888	1,282	12,995
116			71,094	732,225	32,727	346,989	4,947	53,492
117	200	2,050	40,643	415,461	1,873	21,294		
118			12,638	129,977	12,788	135,889	94	1,072
119					4,068	40,345		
29-115	1,210	12,181	14,630	150,356	10,831	114,287	2,405	25,526
116	649	6,038	48,866	502,453	99,705	1,046,139	16,276	188,204
117	10,753	111,094	39,753	416,408	7,454	77,547	319	3,223
118			6,455	66,424	1,705	18,164		
119			931	9,732	2,163	20,864	196	1,963
120			1,041	11,927				
121							282	3,303
30-116	1,280	12,699	56,834	605,524	71,611	756,216	30,313	407,229
117	1,254	13,330	60,813	603,813	12,036	134,226	3,709	37,035
118	126	1,110	30,100	301,004	434	4,540		
119			17,159	186,823	1,868	19,560	369	3,810
120			1,679	20,508				
121			1,203	12,866			246	2,868
31-116			16,248	173,299	9,257	96,464	15,740	172,059
117	875	9,064	136,359	1,456,360	116,473	1,244,708	71,434	818,659
118	618	6,421	72,001	760,188	6,058	63,358	362	4,013
119	218	1,916	9,581	99,310	322	3,424	2,057	2,057
120			394	3,817	3,148	32,900	326	3,317

32-117	2,390	27,083	100,794	1,089,623	140,531	1,519,091	30,929	373,895
118	1,450	16,844	31,696	337,764	34,446	378,194	5,215	69,811
119			1,159	12,212	747	7,823		6,932
120					420	3,877	666	413
121					924	2,387	72	4,208
122					128	1,009	732	732
123					2,480	25,427	985	10,307
124								72
33-117					719	7,562	7	311
118			283	3,069	1,607	16,740	29	522
119					1,275	14,633	51	17,123
120					743	7,912	1,507	18,659
121					5,175	5,175	1,702	175,680
122					490	101,020	16,609	218,235
123					9,467	347,475	20,114	186,096
124					33,022	129,756	17,391	739
34-120							72	30,683
121							2,571	8,142
122					14	140	681	66,878
123					2,634	27,375	6,439	130,322
124							11,647	96,329
125							11,814	3,057
35-121							275	16,305
122							1,507	31,233
123							2,898	73,209
124							6,983	8,127
125							710	10,959
36-122							992	141,499
123							12,748	489,397
124							44,228	289,973
125							26,525	69,131
126							6,700	56,549
127							5,592	38,390
37-123							3,745	293,906
124							28,003	179,961
125							16,464	45,706
126							4,332	
127								
38-125								
126								
127								
39-127								
40-125								
Total	21,402	223,066	873,185	9,205,986	767,516	8,229,957	440,154	4,904,606

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1955—January, 1956, in Numbers and Pounds—Continued

Area	October		November		December		January		Total	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
25-115									9	103
26-114									25,254	310,306
115									8,483	93,145
116									699	7,232
118									1,829	19,561
27-114									9,165	91,065
115									67,339	720,531
116									67,390	716,254
117									9,216	96,310
118									1,037	10,854
119									1,260	12,939
28-115									51,895	549,993
116									125,404	1,363,740
117	2,217	31,348	14,419	199,686	489	5,485			44,994	464,941
118			1,789	20,651	5,004	61,299	5,115	67,771	37,804	422,420
119			2,165	26,412			1,249	17,318	5,317	57,663
29-115									29,514	308,200
116									165,932	1,709,249
117	438	5,850	17	201					86,599	933,724
118	419	6,214	22,257	252,597	6,063	72,855			143,141	1,719,261
119	410	5,478	75,273	892,756	43,400	526,708	15,898	209,731	15,546	194,795
120			2,252	28,000	5,196	72,735	4,808	61,501	1,041	11,927
121									282	3,303
30-116									193,920	2,178,658
117	33,982	396,990	1,170	14,236	16	200			76,126	818,162
118	2,236	32,112	690	7,611	3,368	38,749			34,903	385,126
119			367	4,443	810	9,479			20,573	223,915
120									1,679	20,508
121									1,449	15,734
31-116									41,245	441,822
117			17	201					325,233	3,529,858
118	75	866	3,195	37,052					82,234	871,032
119			22,196	254,447					32,520	361,154
120			1,205	12,770					5,073	52,804

32-117	252	2,916	122	1,353	274,896	3,003,608
118	3,602	42,559	3,602	42,559	72,929	893,966
119					3,598	62,501
120					1,096	10,800
121					1,021	11,046
122					198	1,731
123					3,465	35,734
124						7,634
33-117					726	20,120
118					1,929	15,155
119					1,326	15,155
120					2,800	31,276
121					2,358	25,772
122					26,076	277,300
123					54,136	565,710
124					29,792	315,852
34-120	9	83	183	2,060	81	832
121					2,754	32,743
122					8,282	8,282
123					9,073	94,253
124					11,822	132,347
125					11,814	96,329
35-121					275	3,057
122	5,813	62,603	79	882	7,399	79,790
123	335	3,577			3,203	34,810
124	3,438	35,632	9	105	10,430	109,246
125					710	8,127
36-122					1,038	11,474
123	37	410	9	105	16,263	180,673
124	3,615	39,174			896,876	896,876
125	38,702	407,479			83,029	1,391,557
126	103,053	1,104,479	9	105	129,587	324,919
127	23,364	255,788			50,064	56,549
37-123					5,592	137,623
124	8,971	99,233			12,716	607,583
125	29,606	308,647			57,609	674,337
126	46,263	401,845			62,945	327,102
127	21,035	257,446			30,820	55,632
38-125					4,915	35,975
126	4,732	51,843			3,298	139,134
127					12,483	5,105
39-127					466	855
40-125					87	703
Total	349,236	3,793,862	158,866	1,884,554	27,070	2,701,775
					787,510	29,386,492

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1956–March, 1957, in Numbers and Pounds

Area	June		July		August		September		October	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
27-116			16	303	127	2,072				
117	278	3,761	380	5,704						
118			700	11,748						
119			5,329	83,049						
120					912	12,767				
121					462	6,580				
122					115	1,408				
28-115			2,110	37,574	964	16,851				
116	3,909	62,179	972	15,368	1,686	26,963				
117	357	2,256	4,185	68,900	994	18,827				
118	9,052	112,221	145,907	2,303,499	4,072	74,480			27	579
119			31,257	474,612	5,625	83,833				
120			706	11,367	20,410	277,393				
121					12,226	159,305				
122					3,779	53,774				
29-115			15,427	237,879	320	5,513				
116	16,249	232,541	106,499	1,764,581	16,320	285,538				
117	36,560	527,365	23,947	390,419	5,024	82,991				
118	8,469	116,147	18,646	280,996	6,238	108,440			206	4,386
119	20,480	268,854	453	6,857	12,954	187,161				
120			2,025	31,167	19,229	264,820				
121					1,160	15,196				
122					1,489	19,244				
30-116			85,012	1,271,186	29,398	496,149				
117	28,026	394,917	56,486	917,100	13,465	233,595	915	18,270	309	5,588
118	8,291	117,093	2,407	36,571	33,323	4,565	637	12,812	985	15,399
119	151	1,999	466	6,557	447	5,927	1,367	25,389	1,895	34,035
120					2,905	28,700	305	3,894		
122					39	532				
31-116			18,709	284,389	12,854	215,405				
117	8,284	121,167	169,007	2,527,072	65,121	1,106,087	4,747	77,378	1,299	22,816
118	34,743	498,498	16,021	228,566	3,390	56,771			4,581	75,883
119	4,001	57,972	3,079	43,603	196	2,559	89	1,275	3,498	60,847
120	1,670	26,209	5,041	75,438			39	532	379	5,804
121					15	208	2,457	35,126		
122			153	1,810						

32-117	9,552	132,917	28,479	410,828	38,415	639,273	42	726	818	14,462
118	7,204	99,610	18,246	282,704	2,682	58,665	4	58	1,359	20,309
119			7,213	103,995	2,471	36,944	58	784	2,209	32,362
120			5,591	75,298	707	9,716	278	3,890	5,404	75,347
121					6,368	95,202	417	5,964		
122					66	940	1,506	18,869		
123										
33-117			88	1,328	76	1,260		155	38	807
118			1,831	24,144	2,272	36,609	8	56,440	1,316	20,104
119			253	4,354	26,742	465,507	3,121	4,237	7,797	112,235
120			1,353	19,956	7,613	115,869	251	4,237	24,105	343,252
121			2,341	35,649	42,315	581,320	476	6,141	514	6,270
122					20,455	281,420	286	3,627		
123					595	9,262				
124										
34-120					45	656	66	942	11,917	183,543
121					5,646	75,384	1,873	24,728	33,916	485,711
122					11,510	138,710	3,044	39,147	7,156	90,621
123					9	124	1,510	20,800		
124					477	7,015				
35-120					906	12,350	112	1,669	1,348	19,914
121					4,951	66,487	2,136	32,785	7,364	95,922
122					38,092	499,421	29,993	397,178	682	7,255
123					3,619	47,895	61,357	794,214		
124					272	3,994	10,309	135,008		
125							1,031	13,994		
126										
36-121					12	181	104	1,545	11,251	158,296
122					29,080	405,370	111,527	1,488,484	9,042	114,910
123					68,867	895,486	218,014	2,818,789	3,151	40,343
124					29,863	394,515	92,300	1,190,048	1,023	12,209
125					982	16,220	7,768	98,043	531	6,465
126							1,240	17,648		
37-122					21	269	1,433	19,135	379	5,149
123					2,556	29,682	21,117	13,893	1,034	13,893
124					3,045	39,714	38,564	495,171	1,056	11,868
125					163	2,396	552	8,138	2,258	25,469
126							236	3,260		
38-123							139	1,730		
124							290	3,870		
125							811	11,217	428	5,555
126										
39-124							108	1,317	866	9,632
125							286	3,897		
40-124					18	230	560	7,316		
125							2,260	28,602	8,603	103,875
126							386	4,956		

APPENDIX E—Continued

California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1956–March, 1957, in Numbers and Pounds—Continued

Area	June		July		August		September		October	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
41-124.....							605	9,073		
125.....							232	2,603	25,448	286,455
126.....							85	1,062		
42-124.....							1,298	16,605		
127.....							70	927		
43-126.....							155	2,225		
127.....							23	309		
44-125.....							800	9,216		
126.....							274	3,461		
45-125.....							626	7,285		
126.....							1,070	13,635		
46-124.....									357	3,909
125.....							104	1,306		
126.....							8,772	110,728		
127.....							1,658	14,110		
Total.....	197,427	2,781,048	780,305	12,083,571	593,240	8,821,770	641,390	8,402,438	184,529	2,531,539

**California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1956-March, 1957, in Numbers and Pounds—Continued**

[illegible]

APPENDIX E—Continued

California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1956–March, 1957, in Numbers and Pounds—Continued

Area	November		December		January		February		March		Total	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
32-117	2,855	58,703	1,579	30,862					80,161	1,254,999		
118	118	85,178							35,946	577,386		
119	2,920	36,894	139	2,098					14,329	213,017		
120	2,078	37,242	1,208	16,866					15,266	218,349		
121			2,036	28,648					8,821	129,814		
122	570	8,172	1,123	16,353					3,199	43,424		
123									66	940		
33-117									164	2,588		
118	40	587							4,189	62,302		
119	794	11,119	225	3,306					32,451	560,830		
120	1,450	18,687	2,005	26,989					20,469	298,013		
121	13,479	184,687	14,169	181,002					96,884	1,332,051		
122	8,857	111,641	13,387	167,620					43,499	570,578		
123	104	1,514							699	10,776		
124	247	3,016							247	3,016		
34-120	92	1,306							12,120	186,447		
121	11,033	163,369							52,468	749,192		
122	18,175	262,804	3,391	48,268					43,256	579,550		
123	276	3,845							1,795	24,769		
124									477	7,015		
35-120									112	1,689		
121	2,308	27,886							6,698	92,945		
122	1,352	19,758							43,660	573,345		
123	2,964	38,739							103,095	1,333,629		
124	46	673							13,874	185,576		
125									1,363	17,988		
126	121	1,473							121	1,473		
36-121									116	1,726		
122	230	2,647							152,088	2,051,797		
123	1,237	14,837							297,160	3,844,022		
124	2,411	31,211							127,725	1,656,117		
125	668	8,852							10,441	135,324		
126	2,607	33,979							4,378	58,092		
37-122									1,833	24,553		
123	288	3,747							24,795	318,067		
124	386	5,139							43,061	561,892		
125	581	8,506							3,554	44,509		
126	4,570	66,859							4,806	70,119		

38-123	139	1,730
124	290	3,870
125	2,229	28,173
126	1,571	19,154
39-124	108	1,317
125	1,152	13,529
40-124	578	7,546
125	10,863	132,477
126	386	4,956
41-124	695	9,073
125	25,680	289,058
126	85	1,062
42-124	1,298	16,605
127	70	927
43-126	155	2,225
127	23	309
44-125	800	9,216
126	274	3,461
45-125	626	7,285
126	1,070	13,635
46-124	357	3,969
125	104	1,306
126	8,772	110,728
127	1,058	14,110
Total	2,575,111	37,168,560

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June, 1957–January, 1958, in Numbers and Pounds

Area	June		July		August		September	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
27-118								
28-118	24	345	7	165		2,275		
119			48	666	109			
29-116								
117	48	838	765	13,209				
118	397	1,791	103	1,791				
119	4	68	40,491	835,988	27,679	596,899		
120			2,118	1,584,735	40,786	870,312		
				44,466	4,266	100,919		
30-116								
117	12,279	206,850	29,121	578,640	1,912	42,622		
118	7,470	118,722	15,956	295,059	1,099	26,776		
119	633	12,997	24,370	498,930	21,959	529,003		
120			116,693	2,094,019	83,735	1,737,220		
121			38,608	598,376	43,326	781,981		
122			353	6,759	657	12,864		
31-116								
117	12,127	211,482	4,468	81,409	370	6,682		
118	30,638	500,467	82,861	1,434,626	7,498	160,210	463	12,160
119	2,204	34,021	43,970	681,676	9,788	218,798	1,887	47,466
120			12,076	208,435	24,734	542,491	3,261	68,987
121			42,197	639,717	21,497	483,394		
122			12,742	200,853	5,899	108,182		
					2,652	60,866		
32-117								
118	9,442	151,825	9,925	154,411	3,918	83,952	654	16,623
119	6,548	100,376	97,192	1,449,427	25,209	452,074	19,551	442,676
120	112	1,763	5,027	73,025	450	8,960	31	752
121			4,902	69,299	4,622	72,623	627	10,821
122	40	417	1,169	21,847	4,970	89,361		
123								
124					36	468		
33-117								
118	12	180	1,195	21,869	218	3,722		
119	28	481	3,185	52,972	385	9,298	18	320
120			44,750	686,236	1,153	16,793	9,258	152,542
121	8	84	33,596	481,856	1,810	28,866	18,024	281,796
122			136	2,368	732	10,150	2,968	42,825
123					323	4,288	7,774	104,916

34-120	4,383	59,426	171	2,474	6,776	104,903
121	23,362	323,933	965	14,170	197,523	2,873,481
122	1,191	19,093	41,939	167,600	171,029	2,453,399
123			29,802	405,550	73,032	1,036,854
124			2,148	30,215	2,120	37,748
125						
35-120						
121	18	338	1,125	15,175	31,920	483,370
122	1,063	15,507	32,609	448,642	225,952	3,309,552
123	1,096	13,547	29,606	407,925	114,611	1,642,043
124			2,028	28,644	10,452	151,246
125			472	6,080	423	5,450
36-121						
122	11	136	490	6,787	8,943	158,513
123	629	8,105	149	1,944	25,998	403,255
124	51	614	1,524	20,769	32,231	470,432
125			2,333	33,582	14,282	199,923
37-122						
123			15	192	71	961
124			2,565	32,332	209	3,012
125	33	393	1,059	14,008	4,658	4,658
126	257	3,181	69	932	2,073	27,324
127			65	885		
38-123						
124			979	13,462	218	2,897
125			4	51		
126						
39-124						
125	1,313	16,519			62	756
40-124						
125	195	2,331			5,517	72,565
126					4,262	56,645
41-124						
125	188	2,236			4,854	59,110
126						
42-125						
126	890	10,609				
43-126						
127	1,283	16,140				
44-126						
45-126						
46-124					9	107
47-125					485	5,909
Total	81,645	1,341,953	464,839	8,683,768	1,002,074	11,804,872

34-120	3,934	71,097	639	16,346	15,903	254,246
121	6,306	109,546	3,858	91,661	232,016	3,412,791
122	11,366	175,044	24	372	195,553	2,815,548
123	4,366	67,742	1,526	24,876	108,726	1,535,002
124			129	1,993	4,697	69,956
125			262	4,339	262	4,339
35-120						7,610
121	49,174	891,228	206	7,610	296	1,409,494
122	22,867	367,854	1,087	19,383	83,324	4,176,721
123	3,416	54,874	2,136	35,166	284,747	2,237,859
124	748	11,298	7,267	119,470	155,996	13,400
125			172	2,656	13,400	196,844
					895	11,530
36-121	6,050	103,327			14,993	261,840
122	64,818	1,143,865	2,751	45,642	94,068	1,601,665
123	14,384	224,535	887	13,990	48,280	719,005
124	654	9,297			16,511	230,603
125					6,248	87,477
37-122	13	263			84	1,224
123	761	12,740	24	377	1,009	16,321
124	4,844	73,812			7,778	110,862
125	27	377			3,192	42,162
126					326	4,113
127					65	885
38-123	243	3,652	24	386	267	4,038
124	1,374	22,084	143	1,912	1,517	23,996
125	34	431			1,231	16,790
126					4	51
39-124	741	9,991			803	10,747
126					1,313	16,519
40-124	141	2,129			141	2,129
125	5,956	77,679			11,473	150,244
126	1,678	27,346			6,135	86,322
41-124	552	8,226			552	8,226
125	12,039	170,847			12,039	170,847
126					5,042	61,346
42-125	3,274	47,908			3,274	47,908
126					890	10,609
43-126					1,283	16,140
46-124					9	107
47-125					485	5,909
Total	223,458	3,765,841	61,797	970,933	10,646	153,769
					353	6,129
					2,629,870	43,032,292

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June–November, 1958, in Numbers and Pounds

Area	June		July		August
	Nos.	Lbs.	Nos.	Lbs.	
28-116	22	716			
29-116	96	3,104			
117	11	255			
30-116	4	111			
117	22	314			
120			4	62	
121			498	7,854	256
31-117	860	20,200			
118	454	6,661	3,574	77,657	
119			320	5,905	
120			471	7,106	
121			7,692	114,162	
122			21,159	418,594	438
123			2,875	54,738	
124			320	4,508	
32-117	4	96			
118			104	1,559	
119			841	13,324	
120	218	3,225	95,110	1,342,172	
121			117,110	1,791,037	6,700
122			20,105	381,799	19,413
123			2,335	41,584	3,718
124					779
33-119			286	3,801	
120			39,292	554,423	2,239
121			141,801	2,020,066	30,537
122			80,945	1,249,613	166,988
123			12,702	184,508	15,616
124			610	10,155	2,945
34-120			417	5,241	
121			37,439	528,039	1,619
122	44	602	48,423	706,827	26,314
123			8,121	113,212	36,751
124			675	11,255	15,536
35-121	7	96	486	7,484	
122	520	6,491	94,944	1,349,633	1,278
123			104,354	1,478,187	22,815
124			378	5,593	39,629
125			89	1,312	584
					18,725
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30-122	288	3,867	1,405	19,901	4,570	66,716
123			3,539	48,111	26,149	379,045
124			93	1,220	6,868	104,589
125					548	7,783
126						
37-122					6	103
123					1,862	29,253
124			648	10,332	2,647	38,540
125					548	7,753
126					61	1,138
38-123					55	761
124					128	1,917
125					79	1,126
126					219	3,292
127						
39-124						
125					523	8,362
126					316	4,686
40-125						
126			89	1,177	590	8,654
41-124						
125					688	9,670
126					3,791	53,261
42-125						
126			93	1,227	1,400	19,389
127					18	20,654
43-125						341
126						
127			475	6,295	2,489	35,290
44-124					4,948	71,548
125					310	4,534
126						
127						
45-124					481	7,887
125			8	100	27,178	411,950
126			262	3,481	9,968	142,858
127					4,400	66,114
46-124					791	11,021
125			8	100	13,041	189,395
126			784	10,390	1,436	20,198
47-125						
126					268	4,704
127					304	4,096
48-126					1,747	24,567
					280	5,234
47-125						
126			610	8,086	12	164
127						
48-126						
Total	2,550	45,738	852,006	12,601,406	515,188	9,809,152

APPENDIX E—Continued
California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude
June–November, 1958, in Numbers and Pounds—Continued

Area	September		October		November		Total	
	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.	Nos.	Lbs.
28-116							22	716
29-116							96	3,104
117							11	255
30-116							4	111
117							22	314
120							62	111
121							754	314
31-117							4,434	62
118							774	11,889
119							471	97,857
120							7,692	12,566
121							21,597	7,106
122							2,875	114,162
123							320	425,513
32-117							4	54,738
118							104	2,875
119							841	4,508
120							95	96
121							928	1,559
122	778	24,943					13,324	13,324
123							95	1,345,397
124							124,588	95,328
33-119							39,518	1,997,750
120							6,053	878,228
121							779	104,046
122							286	16,541
123							41,531	3,891
124							172,772	599,316
34-120							256,367	2,601,972
121							28,318	5,455,444
122							3,555	507,755
123							2,036	70,718
124							66,817	37,567
35-121							13	1,070,824
122							94,443	1,461,960
123							28,098	1,461,960
124							2,581	461,323
36-121							7	55,850
122							114	57,879
123							22	1,924,494
124							43	1,924,494
37-121							17	2,334,769
122							2,090	2,334,769
123							89	28,084
124								1,312

36-122	1,937	29,900	1,157	14,831	6	86	9,357	135,215
123	12,554	171,400	5,188	62,983	6	86	47,436	661,925
124	20,517	276,727	14,967	188,988	4	35	42,483	571,134
125	172	2,236	408	6,118	4	35	1,132	16,172
126			23	174			23	174
37-122	52	658					58	761
123	1,421	19,769	650	8,508	11	119	4,592	67,981
124	27,096	373,278	25,411	304,610	32	436	55,186	716,864
125	13,571	158,226	35,453	418,168			50,572	584,147
126	531	9,518	2,155	37,880			2,747	48,486
38-123	135	1,974					190	2,735
124	7,970	115,136	10,444	131,624	1,964	15,722	20,506	264,399
125	1,951	28,233	8,448	103,475	30	276	10,508	133,110
126	860	12,845	6,852	81,074			7,931	97,211
127			711	8,962			711	8,962
39-124	5,570	81,610	30	242			5,600	81,852
125	15,911	211,102	2,261	21,131	1,365	12,622	20,060	253,217
126	1,264	20,307					1,580	24,993
40-125	8,995	122,868					9,585	131,522
126	778	10,438					867	11,615
41-124	217	3,424	53	424			688	9,670
125	1,727	24,068					4,061	57,109
126							1,727	24,068
42-125	3,566	56,353	144	1,142			5,110	76,884
126	9,877	144,072					11,345	165,953
128							18	341
43-125							2,489	35,290
126							77,843	77,843
127							5,423	4,534
44-124	9,017	139,070	15	254			481	7,887
125							36,218	551,354
126							10,230	146,339
127							4,400	66,114
45-124	389	5,271					701	11,021
125							13,438	194,766
126							2,220	30,588
46-124	4,426	68,361	1,815	28,036			268	4,704
125							6,545	100,493
126							1,747	24,867
127							280	3,234
47-125							12	164
127							610	8,086
48-126							112	1,486
Total	207,628	3,119,370	121,065	1,483,081	3,514	30,503	1,702,551	27,179,250

California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude

June–November, 1959, in Numbers, Pounds and Days Fished *

Area	June			July			August			September			October			November			Total	
	Numbers (Nos. per Day)	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers (Nos. per Day)	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers (Nos. per Day)	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers (Nos. per Day)	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers (Nos. per Day)	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers (Nos. per Day)	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers (Nos. per Day)	Pounds (Lbs. per Day)
29-117.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
30-116.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
117.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
118.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
119.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
120.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
31-117.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
118.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
119.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
120.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
121.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
32-117.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
118.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
119.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
120.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
121.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
33-116.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
119.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
120.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
121.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
34-110.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
120.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
121.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
35-120.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
121.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
36-121.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
37-122.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
38-123.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
39-124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
127.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
40-124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
127.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
41-125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
127.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
42-125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
43-125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
127.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
44-124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
45-124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
46-125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
47-124.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
125.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
48-126.....				0 (0)	0 (0)	2 (1)													0 (0)	0 (0)
Total.....	28,630 (48)	350,952 (501)	554 (244)	709,345 (111)	8,709,208 (1,301)	6,401 (2,856)	977,965 (135)	12,495,706 (1,731)	7,220 (3,072)	769,430 (103)	10,026,085 (2,854)	8,356 (1,210)	77,310 (75)	1,104,763 (1,070)	1,024 (380)	2,951 (25)	45,737 (381)	120 (44)	2,533,640 (132)	32,732,451 (1,595)

* Monthly catch-per-day figures in each 1-degree square are from the sample; the totals, however, represent the entire catch, and slight differences are caused by rounding to the nearest day.



California Commercial Albacore Catch by One-Degree Areas of Latitude and Longitude

June-December, 1960, in Numbers, Pounds and Days Fished *

Area	June			July			August			September			October			November			December			Total	
	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)	Days (Sample Days)	Numbers per Day	Pounds (Lbs. per Day)
27-117																						0	0
28-118																						0	0
119				60	1,054 (513)	2																0	0
29-118				2																		0	0
119				2	36 (18)	2																0	0
120				389	4,338 (2,256)	2																0	0
121	684 (100)	7,720 (1,226)	6																			0	0
30-117	17 (4)	281 (69)	4																			0	0
118	1,555 (57)	19,005 (730)	27	15,725 (163)	218,470 (7,265)	96																0	0
120	14,086 (689)	167,783 (4,677)	157	59,117 (4,677)	739,160 (2,410)	349																0	0
121	3,682 (82)	4,005 (1,005)	21	1,039 (183)	1,721 (2,172)	1																0	0
122																						0	0
123																						0	0
31-117	55 (9)	1,007 (160)	6	265 (64)	3,552 (896)	4																0	0
118	3,784 (65)	57,683 (833)	69	31,531 (833)	458,782 (1,944)	236																0	0
119	4,329 (82)	60,585 (1,555)	60	82,335 (1,555)	1,100,580 (2,410)	281																0	0
121	6,768 (105)	84,452 (1,307)	76	4,053 (1,116)	50,378 (1,116)	22																0	0
122	1,607 (87)	1,012 (1,012)	8	1,039 (104)	1,209 (1,209)	1																0	0
123																						0	0
124	15 (7)	177 (94)	2																			0	0
32-117	418 (17)	5,750 (238)	25	2,130 (94)	30,193 (1,337)	23																0	0
118	12,951 (33)	196,219 (470)	371	87,350 (328)	1,424,439 (2,277)	856																0	0
119	2,957 (55)	32,402 (822)	21	41,052 (1,045)	574,050 (1,307)	632																0	0
120	4,181 (62)	49,954 (744)	67	123,006 (2,022)	1,667,386 (2,638)	308																0	0
121	6,487 (88)	77,910 (1,118)	55	24,500 (357)	319,290 (942)	166																0	0
122				7,597 (100)	94,822 (1,209)	21																0	0
123																						0	0
124																						0	0
33-117																						0	0
118	15 (2)	231 (37)	6																			0	0
119				2,443 (42)	34,083 (638)	61																0	0
120	1,492 (51)	17,594 (569)	29	56,001 (1,774)	733,792 (2,277)	322																0	0
121	2,057 (35)	32,402 (822)	21	83,535 (2,188)	1,100,580 (2,410)	281																0	0
122	619 (33)	7,619 (403)	19	15,533 (329)	155,222 (4,136)	47																0	0
123	13 (6)	159 (76)	2	1,777 (2,616)	21,911 (2,616)	8																0	0
124																						0	0
125																						0	0
34-119																						0	0
120																						0	0
121	309 (15)	3,581 (1,171)	10	120,834 (2,188)	1,500,992 (2,410)	497																0	0
122				21,021 (357)	26,311 (357)	9																0	0
123																						0	0
124																						0	0
125																						0	0
35-121	101 (5)	1,192 (608)	2	11,940 (1,811)	145,907 (2,172)	95																0	0
122	51 (15)	6,085 (1,811)	21	14,583 (1,811)	178,318 (2,172)	82																0	0
123	42 (10)	469 (112)	2																			0	0
124	82 (20)	855 (422)	2																			0	0
125																						0	0
36-121																						0	0
122																						0	0
123																						0	0
124																						0	0
125																						0	0
126																						0	0
37-122																						0	0
123																						0	0
124																						0	0
125																						0	0
126																						0	0
38-123																						0	0
124																						0	0
125																						0	0
126																						0	0
39-124																						0	0
125																						0	0
126																						0	0
40-124																						0	0
125																						0	0
126																						0	0
41-124																						0	0
125																						0	0
126																						0	0
42-125																						0	0
126																						0	0
43-125																						0	0
126																						0	0
44-124																						0	0
125																						0	0
126																						0	0
45-124																						0	0
125																						0	0
126																						0	0
46-125																						0	0
126																						0	0
47-125																						0	0
Total	78,059 (58)	1,017,746 (743)	1,370 (655)	880,264 (160)	11,780,553 (2,146)	5,493 (2,677)	951,374 (136)	13,395,426 (1,910)	7,015 (2,910)	393,623 (106)	6,340,211 (1,703)	3,724 (315)	145,266 (61)	2,340,043 (377)	2,394 (352)	988 (5)	13,885 (56)	210 (30)	0 (0)	0 (0)	2 (2)	2,450,474 (131)	34,880,894 (7,177)

* Monthly catch-per-day figures in each 1-degree square are from the sample; the totals, however, represent the entire catch, and slight differences are caused by rounding to the nearest day.



June–November, 1961, in Numbers, Pounds and Days Fished *



APPENDIX F

**Statistics of the California Commercial Albacore Fishery
from Sales Receipts, 1931-1961**

Calendar year	Total boats landing albacore	Number of "selected" boats	Boat-months fished	Catch (pounds)	Catch per boat-month
1931	122	73	76	35,542	467.7
1932	233	229	242.5	619,387	2,554.2
1933	5	1	1	172	172.0
1934	174	143	153	116,663	762.5
1935	673	630	1,407.5	2,430,851	1,727.1
1936	558	443	1,062	931,329	877.0
1937	800	746	1,156.5	2,010,314	1,738.3
1938	909	827	1,901.5	4,669,761	2,455.8
1939	1,085	1,005	2,258.5	8,202,492	3,631.8
1940	905	825	1,545	2,372,816	1,535.8
1941	558	524	802.5	2,861,883	3,566.2
1942	1,203	1,203	2,803	10,621,360	3,789.3
1943	1,762	1,622	3,685	20,825,672	5,651.5
1944	1,427	1,329	3,519	18,027,525	5,122.9
1945	1,640	1,500	4,264.5	19,986,613	4,686.7
1946	2,177	1,970	5,550.5	17,592,890	3,169.6
1947	2,183	1,970	4,607.5	12,904,805	2,800.8
1948	2,873	2,594	6,292	32,680,798	5,194.0
1949	3,121	2,881	6,568	40,053,604	6,098.3
1950	3,161	2,998	8,224.5	60,688,807	7,379.0
1951	2,112	2,000	4,620	30,138,714	6,523.5
1952	2,149	2,047	5,500	49,113,801	8,929.8
1953	1,835	1,726	4,261.5	32,885,560	7,716.9
1954	1,606	1,539	3,804.5	25,865,554	6,798.7
1955	1,081	1,081	2,934	29,002,298	9,884.9
1956	1,290	1,239	3,366	36,696,119	10,902.0
1957	1,232	1,190	3,288.5	42,436,794	12,904.6
1958	1,030	998	2,508.5	26,241,947	10,461.2
1959	933	914	2,135.5	30,589,855	14,324.4
1960	896	861	1,974.5	31,554,845	15,981.2
1961	1,045	970	2,178.5	26,196,928	12,025.2

APPENDIX G

**Value of California Commercial Albacore Landings Based on Price Per Ton
to the Fishermen, 1939-1961**

Calendar year	Tons landed	Value (thousand dollars)	Dollars per ton
1939	5,000	559	112
1940	1,970	275	140
1941	1,670	403	241
1942	5,310	2,018	380
1943	10,690	3,477	325
1944	9,230	3,066	332
1945	10,610	4,137	390
1946	9,040	3,589	397
1947	6,590	3,080	467
1948	18,230	10,678	586
1949	22,000	8,142	370
1950	30,870	11,725	380
1951	15,460	4,867	315
1952	24,900	8,628	346
1953	16,920	6,741	398
1954	13,050	5,248	402
1955	14,500	4,700	324
1956	18,530	6,333	342
1957	21,760	6,281	289
1958	13,590	5,567	410
1959	16,370	6,083	372
1960	17,560	5,177	295
1961	14,560	5,189	356

APPENDIX H
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
July–November, 1936

Area	July			August			September		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32°-117°.....	8	3	.375	12	1	.083	12	1	.083
33°-117°.....	21	6	.286	29	11	.379			
117°.....	20	11	.550	4	3	.750			
118°.....	11	6	.545	8	8	1.000			
33°-117°.....	115	86	.748	9	7	.778	37	5	.135
118°.....	84	39	.464	21	20	.952			
118°.....	101	38	.376	140	70	.500	207	59	.285
34°-118°.....				60	1	.017			
118°.....				35	1	.029			
34°-118°.....	2	1	.500						
119°.....							6	3	.500
Total.....	362	190	0.525	318	122	0.384	262	68	0.260

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
July–November, 1936—Continued

Area	October			November			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32-117-.....							32	5
33-117-.....							50	17
117-.....							24	14
118-.....	41	27	.659	33	1	.030	93	42
33-117-.....							161	98
118-.....	22	2	.091				127	61
118-.....	86	18	.209				534	185
33-118-.....							60	1
118-.....	10	25	2.500				45	26
34-118-.....							2	1
118-.....							6	3
Total.....	159	72	0.453	33	1	0.030	1,134	453

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June—September, 1937

Area	June			July		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32-117-.....	264	56	.212	24	2	.083
32-117-.....	3	28	9.333			
33-117-.....	13	28	2.154	4	6	1.500
33-118-.....	94	26	.277	55	17	.309
				6	2	.333
33-117-.....	91	212	2.330	80	82	1.025
33-118-.....	105	126	1.200	110	112	1.018
33-118-.....	197	110	.558	50	27	.540
33-118-.....						
34-118-.....	35	20	.571			
Total	802	606	0.756	329	248	0.754

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–September, 1937—Continued

Area	August			September			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32°-117°-----	14	5	.357				302	63
32°-117°-----							3	28
33°-117°-----							17	34
118°-----							149	43
118°-----							6	2
33°-117°-----	82	89	1.085	4	6	1.500	257	389
118°-----	168	85	.506				383	323
118°-----	397	120	.302	40	1	.025	684	258
33°-118°-----							28	90
118°-----	28	90	3.214				97	94
118°-----	97	94	.969					
34°-118°-----				3	2	.667	38	22
Total-----	786	483	0.615	47	9	0.191	1,964	1,346

APPENDIX H—Continued

**California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–October, 1938**

Area	May			June			July		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
29 ₀ -118 ₀							21	12	.571
32 ₂ -117 ₀	8	1	.125				50	3	.060
117 ₂							9	37	4.111
32 ₄ -117 ₀							6	9	1.500
117 ₂									
33 ₀ -117 ₂							57	78	1.368
117 ₄							184	21	.114
118 ₀							20	1	.050
118 ₂									
33 ₂ -117 ₂				39	1	.026	76	51	.671
117 ₄							270	169	.626
118 ₀				18	11	.611	312	364	.364
118 ₂							856	850	.257
119 ₀							3,306		
33 ₄ -118 ₀							25	18	.720
118 ₂									
118 ₄							4	4	1.000
119 ₂									
34 ₀ -118 ₄							9	2	.222
36 ₂ -121 ₄									
36 ₄ -121 ₄									
Total.....	8	1	0.125	57	12	0.211	4,893	1,567	0.320

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–October, 1938—Continued

Area	August			September			October			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
29a-118o-----				12	1	.083				33	13
32a-117o-----	2	14	7.000	68	3	.044				128	21
117a-----	3	6	2.000	21	6	.286				33	49
32a-117o-----				3	1	.333				9	10
117a-----				1	2	2.000				1	2
33a-117a-----				4	14	3.500				4	14
117a-----	26	19	.731							83	97
118o-----				155	20	.129				339	41
118a-----										20	1
33a-117a-----				83	14	.169	7	5	.714	205	71
117a-----	48	33	.688	387	375	.969	30	13	.433	735	590
118o-----	333	367	1.072	325	137	.422	33	25	.758	1,565	842
118a-----	659	187	.284	1,102	512	.465	13	20	1.538	5,080	1,569
119o-----				75	56	.747	79	18	.228	154	74
33a-118o-----										25	18
118a-----	12	2	.167	16	22	1.375				28	24
118o-----				40	16	.400	2	7	3.500	42	23
119a-----	6	2	.333							10	6
34a-118a-----										9	2
36a-121a-----	6	2	.333	24	86	3.583	2	3	1.500	32	91
36a-121a-----				8	53	7.250				8	58
Total-----	1,095	622	0.568	2,324	1,323	0.569	166	91	0.548	8,543	3,616

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–October, 1939

Area	May			June			July		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
29°-118°									
32°-117°							46	116	2.522
117°							12	11	.917
32°-117°									
117°									
118°							37	27	.730
33°-117°									
117°									
118°							7	9	1.286
118°							18	19	1.056
33°-117°									
117°									
118°	3	1	.333				68	14	.206
118°							516	558	1.081
118°							607	407	.671
119°				2	9	4.500	1,132	340	.300
119°							18	45	2.500
119°							202	105	.520
33°-118°									
118°									
119°							70	47	.671
119°							122	62	.508
34°-119°									
35°-121°									
36°-121°									
121°									
122°									
36°-121°									
37°-122°									
Total	3	1	0.333	2	9	4.500	2,855	1,760	0.616

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–October, 1939—Continued

Area	August			September			October			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
29°-118°	24	6	.250	36	1	.028				24	6
32°-117°	2	1	.500							82	117
32°-117°										12	12
32°-117°	7	3	.429	32	1	.031				39	4
117°	6	5	.833							6	5
118°	70	97	1.386	82	70	.854				189	194
33°-117°	33	32	.970							33	32
117°	568	400	.704							575	409
118°	307	39	.127	2	1	.500				327	59
118°	342	138	.404	12	3	.250				354	141
33°-117°	765	293	.383	63	3	.048				896	310
117°	2,236	1,948	.871	230	37	.161				2,543	2,982
118°	1,479	1,929	.628	114	32	.281				2,203	1,369
118°	4,575	1,691	.370	204	23	.113				5,913	2,063
119°	55	34	.618							73	79
119°	936	707	.755							1,138	812
33°-118°	349	73	.209							419	120
118°	313	228	.728	49	17	.347				435	290
119°	98	18	.184							147	35
34°-119°				18	8	.444				18	8
35°-121°	3	11	3.667							3	11
36°-121°	5	1	.200							13	4
122°	2	1	.500						.375	8	4
122°	15	75	5.000	22	37	1.682			1.550	20	143
36°-121°	5	18	3.600							5	18
37°-122°				11	28	2.545					
Total	12,195	6,748	0.553	875	261	0.298	36	37	1.028	15,966	8,816

APPENDIX H—Continued

California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude

July–September, 1940

Area	July			August			September			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32°-117°-117s	102	2	.020	12	6	.500				102	2
33°-117°-118s	2	9	4.500	2	2	1.000				12	6
33°-118°-118s	55	40	.727							2	9
118s	148	46	.311	114	4	.035		3	.250	2	2
119s	16	24	1.500	2	1	.500	12			55	40
36°-121°										274	53
										2	1
										16	24
							4	5	1.250	4	5
Total	323	121	0.375	130	13	0.100	16	8	0.500	469	142

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–November, 1947

Area	June			July			August		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32 ₂ -117 ₀ -----							176	57	.324
118 ₀ -----				2	1	.500	8	68	8.500
118 ₂ -----									
32 ₄ -117 ₀ -----				20	6	.300	2	6	3.000
118 ₀ -----				15	75	5.000	34	24	.706
118 ₂ -----				4	1	.250	53	27	.509
33 ₀ -117 ₂ -----							625	548	.877
118 ₀ -----				387	1,950	5.039	590	164	.278
118 ₂ -----	30	30	1.000				110	110	.241
118 ₄ -----							4	4	1.000
33 ₂ -117 ₂ -----				10	1	.100	462	260	.563
117 ₄ -----	8	2	.250	29	14	.483	4,219	2,414	.572
118 ₀ -----	15	1	.067	42	39	.929	1,853	951	.513
118 ₂ -----	18	1	.056	511	1,936	3.789	2,419	757	.313
118 ₄ -----							4	9	2.250
118 ₆ -----							20	40	2.000
33 ₄ -118 ₀ -----									
118 ₂ -----	5	3	.600				133	15	.113
118 ₄ -----							4	1	.250
34 ₀ -118 ₄ -----							74	22	.297
Total-----	76	37	0.487	1,020	4,023	3.944	11,137	5,477	0.492

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–November, 1947—Continued

Area	September			October			November			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32°-117°-118°-118°-							176			176	57
118°-							2			2	1
118°-							8			8	68
32°-117°-118°-											
118°-							20			20	6
118°-							49			49	6
33°-117°-117°-	184	155	.842								
117°-	111	65	.586							241	183
118°-	99	16	.162							788	647
118°-	91	14	.154				52	34	.654	1,106	2,100
118°-				6	2	.333				554	126
118°-										4	4
33°-117°-117°-	389	253	.650								
117°-	1,288	717	.557	8	2	.250				861	514
118°-	527	456	.865	2	4	2,000				5,352	3,149
118°-	167	110	.659	75	21	.280				2,439	1,451
118°-	8	4	.500							3,190	2,825
119°-										12	13
										20	40
33°-118°-118°-	5	7	1.400							5	7
118°-										138	18
118°-										4	1
34°-118°-	68	40	.588	19	8	.421					
Total-----	2,937	1,837	0.625	110	37	0.336	52	34	0.654	15,332	11,445

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–October, 1948

Area	May			June			July		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
29 ₀ -118 ₀									
31 ₁ -117 ₂									
32 ₂ -117 ₀							423	296	.700
117 ₂							5	21	4.200
117 ₄									
32 ₄ -117 ₀									
117 ₂							34	4	.118
117 ₄							7	8	1.143
118 ₀							23	17	.739
118 ₂							25	7	.280
33 ₀ -117 ₂									
117 ₄	13	26	2.000				168	91	.542
118 ₀							119	75	.630
118 ₂							423	317	.749
33 ₂ -117 ₂							107	37	.346
117 ₄									
118 ₀							131	184	1.405
118 ₂							1431	918	.642
118 ₄				36	14	.389	1866	1,406	.758
119 ₀				41	58	1.415	1,248	467	.374
119 ₂									
33 ₄ -118 ₀									
118 ₂							15	13	.867
118 ₄									
119 ₀							40	10	.250
119 ₂									
34 ₀ -118 ₄									
37 ₄ -122 ₄									
Total.....	13	26	2.000	77	72	0.935	6,055	3,871	0.639

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–October, 1948—Continued

Area	August			September			October			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
29°-118°				6	1	.167				6	1
31° 117°				6	44	7.333				6	44
32°-117°	68	24	.353							491	320
117°	6	12	2.000							11	33
117°	23	17	.739							23	17
32°-117°	25	1	.040							25	1
117°	55	72	1.309							89	76
117°	4	8	2.000							11	16
118°										23	17
118°	6	4	.667							31	11
33°-117°	130	85	.654	11	2	.182				325	204
117°	271	116	.428	35	76	2.171				425	267
118°	1,204	521	.433	128	83	.643				1,756	621
118°	262	179	.683	53	3	.057				422	219
33°-117°	336	102	.304	86	23	.267				553	309
117°	3,071	1,400	.456	1,637	1,171	.702				6,209	3,513
118°	6,266	3,591	.570	1,198	695	.580	4	10	2.500	9,391	5,790
118°	4,162	2,069	.481	813	400	.492	82	13	.159	6,305	2,880
118°	30	8	.267							20	8
118°	324	76	.235	30	11	.367				354	87
119°	873	473	.542							888	486
33°-118°	236	54	.229	9	1	.111				285	65
118°	153	95	.621	56	28	.500				225	126
118°	19	3	.158	17	15	.882	16	3	.188	36	18
119°	2	4	2.000							2	4
119°	8	3	.375	18	11	.611				26	14
34° 118°	6	6	1.000							6	6
37°-122°	5	1	.200							5	1
Total	17,565	8,855	0.504	4,137	2,564	0.620	102	26	0.255	27,949	15,414

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–October, 1949

Area	June			July			August		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32°-117°	15	18	1.200	959	1,416	1.477	26	13	.500
117°-118°				7	5	.714			
32°-117°				90	73	.811			
117°-118°				6	5	.833			
118°-119°				36	2	.056	4	1	.250
119°-120°									
33°-117°				560	470	.839	606	656	1.083
117°-118°				1,424	1,852	1.301	515	395	.767
118°-119°				1,024	669	.653	652	380	.583
119°-120°				162	13	.080	24	4	.167
33°-117°				1,488	915	.615	237	225	.949
117°-118°				5,925	5,273	.890	2,596	1,465	.564
118°-119°				3,642	2,745	.754	4,117	3,441	.836
119°-120°				4,449	1,416	.318	2,772	951	.343
33°-117°				8	2	.250			
117°-118°				27	15	.556	199	111	.558
118°-119°									
34°-119°									
35°-120°									
37°-123°									
38°-123°									
Total	39	49	1.256	19,807	14,871	0.751	11,776	7,643	0.649

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–October, 1949—Continued

Area	September			October			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32°-117° 117°	---	---	---	---	---	---	1,000 7	1,447 5
32°-117° 117°	---	---	---	---	---	---	4	1
117°	---	---	---	---	---	---	90	73
118°	---	---	---	---	---	---	6	5
118°	21	1	.048	---	---	---	85	4
33°-117° 117°	10	2	.200	---	---	---	1,176	1,128
117°	---	---	---	---	---	---	1,332	2,247
118°	---	---	---	---	---	---	1,576	1,049
118°	13	1	.077	---	---	---	199	18
33°-117° 117°	---	---	---	---	---	---	1,725	1,140
117°	102	51	.500	---	---	---	8,625	6,797
118°	139	49	.353	---	---	---	7,914	6,284
118°	124	18	.145	---	---	---	7,351	2,389
33°-118° 118°	---	---	---	---	---	---	8	2
---	---	---	---	---	---	---	226	126
34°-119° ---	12	1	.083	---	---	---	12	1
35°-120° ---	---	---	---	3	1	.333	3	1
37°-123° ---	2	3	1.500	---	---	---	2	3
38°-123° ---	---	---	---	7	2	.286	7	2
Total	423	126	0.298	10	3	0.300	32,055	22,692

APPENDIX H—Continued

California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–December, 1950

Area	May			June			July			August		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32°-117°				353	352	.997	794	855	1.077	48	11	.229
117°				7	7	1.000	13	1	.077	2	3	1.500
1174												
1184												
32°-117°							16	7	.438	35	9	.287
1172							54	1	.019	15	28	1.867
1174				18	56	3.111	22	55	2.500	10	15	1.500
1176							84	131	1.560			
1186				241	66	.274	203	65	.320		6	.133
1182												
33°-117°				71	9	.122	36	25	.694	37	11	.297
1172				122	48	.393	1,492	1,217	.816	1,261	1,200	.952
1174							1,110	1,395	1.247	1,253	1,094	.873
1186				480	64	.133	1,542	1,631	1.058	653	461	.706
1182							694	275	.396	216	166	.769
1196										63	103	1.635
1192										87	119	1.368
33°-117°				127	25	.197	1,795	1,208	.673	689	329	.478
1172				1,209	505	.418	16,430	20,195	1.229	9,604	8,015	.835
1174							111,153	15,057	1.350	7,755	6,942	.805
1184				387	73	.189	10,053	10,507	1.045	10,366	9,767	.942
1182							171	201	1.175	2,280	2,653	1.164
1186							78	40	.513	187	88	.471
33°-118°							98	188	1.918	79	43	.544
1182							8,287	9,605	1.159	7,850	4,784	.609
1184							309	635	2.055	423	459	1.085
1186							121	99	.818	30	62	2.067
1192							171	151	.883	8	2	.250
1194							82	103	1.256			
1206							8	42	5.250			
1202							11	18	1.636			

34-118	14	40	2,857	92	28	.304
118	38	20	.526	112	37	.330
119	69	71	1,029	27	49	1,815
119	178	153	.860	45	6	.133
35-120				10	5	.500
120				15	26	1,733
35-121						
35-121						
36-121						
37-122						
122	5	1	.200	8	8	1,000
41-124				2		
Total	62	63,992	1,161	43,307	36,533	2,000
		55,140	0,399			0,844

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APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–November, 1951

Area	June			July			August		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32°-117°.....	11	9	.818	1,065	710	.667	510	211	.414
32°-117°.....				164	139	.848	77	17	.221
117°.....				9	15	1.667	25	67	2.680
117°.....									
118°.....				308	320	1.039	35	4	.114
33°-117°.....				15	3	.200	27	58	2.148
117°.....				456	253	.555	2,116	2,722	1.286
117°.....				829	562	.678	2,005	2,452	1.223
117°.....				2,388	1,288	.539	1,005	1,188	.740
118°.....				423	181	.428	147	212	1.442
118°.....									
33°-117°.....				442	129	.292	806	767	.952
117°.....				2,990	2,076	.694	9,298	12,732	1.369
117°.....				7,822	7,383	.945	15,861	21,871	1.379
118°.....				3,437	1,699	.494	4,825	2,463	.510
118°.....				20	15	.750			
118°.....				422	99	.235	64	7	.109
119°.....									
33°-118°.....				145	125	.862	255	161	.631
118°.....				1,349	377	.279	2,295	1,720	.749
118°.....				436	140	.321	65	111	1.708
118°.....				94	51	.543			
119°.....				76	83	1.092	30	8	.267
119°.....									
34°-118°.....				24	21	.875	87	59	.678
118°.....				11	18	1.636	9	3	.333
119°.....				63	16	.254			
119°.....				15	21	1.400			
119°.....									
35°-120°.....							6	3	.500
35°-120°.....									
121°.....									
37°-122°.....									
Total.....	11	9	0.818	23,003	15,734	0.684	40,148	46,836	1.167

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–November, 1951—Continued

Area	September			October			November			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32 ₂ –117 ₀ -----	58	48	.828	17	2	.118				1,661	980
32 ₄ –117 ₀ -----										241	156
117 ₂ -----										34	82
117 ₄ -----	16	33	2.063							33	33
118 ₂ -----				54	30	.556				397	354
33 ₀ –117 ₀ -----											76
117 ₂ -----	478	670	1.402	28	15	.536				70	3,756
117 ₄ -----	1,414	1,145	.810	52	111	2.135				3,102	3,756
118 ₀ -----	662	361	.545	80	40	.500				4,328	4,199
118 ₂ -----	12	6	.500	330	135	.409				5,021	2,995
				633	326	.515				1,225	727
33 ₂ –117 ₂ -----	387	267	.728	87	32	.368					1,195
117 ₄ -----	2,900	2,702	.932	253	114	.451				1,702	17,624
118 ₀ -----	3,362	2,757	.820	392	316	.806				15,441	33,169
118 ₂ -----	1,933	986	.510	141	68	.482				28,136	5,831
118 ₄ -----										10,993	186
119 ₀ -----										136	106
119 ₂ -----										486	
33 ₄ –118 ₀ -----	33	9	.273	37	2	.054				489	347
118 ₂ -----	1,360	1,191	.876							5,274	3,427
118 ₄ -----	144	128	.889							645	379
119 ₀ -----										94	51
119 ₂ -----										106	91
34 ₀ –118 ₂ -----											80
118 ₄ -----										111	40
119 ₀ -----				31	7	.226				40	10
119 ₂ -----										11	18
119 ₄ -----										16	63
										15	21
35 ₀ –120 ₄ -----										6	3
35 ₂ –120 ₄ -----	5	1	.200							5	1
121 ₀ -----	35	8	.229							35	8
37 ₄ –122 ₄ -----	6	3	.500								3
Total-----	12,785	10,315	0.807	2,135	1,198	0.561	1,807	1,832	1.014	79,889	75,924

Age	1	0.111	33	1	0.030	141	87	0.617	49,387	58,745	1.189
33-118	9	1									
118									71	18	.254
118									225	80	.356
118											
119											
119									107	47	.439
119									39	50	1.252
120											
120											
34-119											
119											
119											
37-123											
123											
39-124									6	5	.833
124											
Total	9	1	33	1	0.030	141	87	0.617	49,387	58,745	1.189

33-118	152	15	.099	16	26	1.625											223	33
118	167	114	.683														408	220
118	62	86	1.387														62	86
119	150	96	.640														257	143
119	46	4	.087														85	54
120				19	2	.105											19	2
34-119	41	69	1.683														41	69
119	23	12	.522														23	12
37-123											5	3	.600				5	3
39-124																	6	5
Total	70,495	113,257	1.607	10,707	13,862	1.295	1,658	1,307	0.788	11	7	0.636	132,441	187,267				

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–September, 1953

Area	May			June			July		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
28 ₊ -118 ₊							20	68	3.400
32 ₊ -117 ₊				170	141	.829	2,036	1,005	.494
117 ₊							98	51	.520
118 ₊							15	7	.467
32 ₊ -117 ₊				18	1	.056	233	68	.292
117 ₊							37	24	.649
117 ₊							60	12	.200
118 ₊							417	356	.854
118 ₊							948	286	.302
119 ₊							35	35	1.000
119 ₊									
33 ₊ -117 ₊							46	41	.891
117 ₊	5	17	3.400	4	1	.250	1,148	847	.738
117 ₊							1,227	682	.556
118 ₊							7,853	5,894	.751
118 ₊				80	9	.113	1,789	1,197	.681
118 ₊							251	151	.602
118 ₊									
119 ₊									
119 ₊									
119 ₊									
33 ₊ -117 ₊				15	1	.067	13	42	3.231
117 ₊	29	7	.241	73	22	.301	784	222	.283
117 ₊	40	2	.050	17	24	1.412	2,450	954	.389
118 ₊				25	10	.400	6,481	3,354	.518
118 ₊							6,587	3,962	.601
118 ₊							498	604	1.213
119 ₊							40	16	.400
119 ₊									
33 ₊ -118 ₊									
118 ₊							576	252	.438
119 ₊							127	113	.889
119 ₊							37	38	1.027
119 ₊							54	23	.426
119 ₊									
34 ₊ -119 ₊							83	44	.530
119 ₊									
34 ₊ -120 ₊									
37 ₊ -123 ₊									
Total	74	26	0.351	402	209	0.520	33,913	20,348	0.600

APPENDIX H—Continued
**California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
 May–September, 1953—Continued**

Area	August			September			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
28 ₄ -118 ₅							20	68
32 ₂ -117 ₆	104	23	.221				2,310	1,169
117 ₄							98	51
118 ₆							15	7
32 ₂ -117 ₆							251	69
117 ₂							37	24
117 ₄	20	5	.250				80	17
118 ₆							429	357
12							1,029	293
118 ₂	81	7	.086				35	35
119 ₂							34	23
119 ₄	34	23	.676					
33 ₂ -117 ₆							46	41
117 ₂	7	2	.286				1,164	867
117 ₄	6	4	.667				1,233	686
118 ₆	103	55	.534				8,036	5,958
118 ₂	343	189	.551				2,102	1,386
118 ₄	372	13	.181				323	164
119 ₂	61	28	.459				61	28
119 ₄	271	112	.413				271	112
119 ₆							13	42
33 ₂ -117 ₂							828	230
117 ₂	37	1	.027				2,600	979
117 ₄	141	49	.348				6,868	3,442
118 ₆	662	463	.699	29	15	.517	7,285	4,436
118 ₂	1,479	1,479	.776	11	1	.091	2,405	2,083
119 ₂	273	108	.397				312	124
119 ₄	82	75	.915				82	75
33 ₂ -118 ₂							736	286
118 ₂	160	34	.213				127	113
118 ₄							63	18
119 ₆	26	10	.385				101	61
119 ₂	47	38	.809					
34 ₂ -119 ₂							130	72
119 ₄	47	28	.596				10	15
119 ₆	10	15	1.500					
34 ₂ -120 ₄								
37 ₄ -123 ₆				2	1	.500	2	1
	10	1	.100				10	1
Total	4,615	2,763	0.612	42	17	0.405	38,946	23,363

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–October, 1954

Area	June				July			August		
	Anglers	Fish	Fish per angler		Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
29°-118°					89	122	1.371			
32°-117°	21	5	.238		2,706	998	.358	68	239	3.515
117°					52	42	.808			
118°					80	17	.283			
118°					103	62	.602	19	4	.211
32°-117°					37	18	.486			
117°					6	1	.167			
117°					105	68	.648	14	1	.071
117°					1,193	615	.516	3,451	3,451	1.058
118°					1,847	792	.429	601	667	1.110
118°					244	161	.660			
118°					82	164	2.000			
119°										
33°-117°					430	258	.600	19	19	1.000
117°					1,418	853	.602	203	324	1.596
117°					2,003	767	.383	340	170	.500
118°					1,546	584	.378	3,208	2,953	.921
118°	14	10	.714		1,918	1,690	.881	539	390	.724
118°					299	299	.842	1,606	1,446	.900
119°					355	83	1.163	338	338	.669
119°					80			173	141	.815
33°-117°					26	4	.154	76	174	2.289
117°					723	346	.479	127	84	.661
118°					526	187	.356	202	147	.728
118°					257	187	.339	73	73	.646
118°					166	166	.940	155	96	.619
119°					291	302	1.038	623	533	.856
33°-118°								69	18	.261
35°-121°										
35°-121°										
35°-121°										
36°-121°										
Total	35	15	0.429		16,263	8,656	0.532	11,922	11,268	0.945

**California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–October, 1954—Continued**

Area	September			October			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
29°-118°							89	122
32°-117°							2,795	1,212
117°							52	42
118°							17	17
118°							122	66
32°-117°							37	18
117°							6	1
117°							119	69
118°							4,455	4,066
118°							2,448	1,459
118°							244	161
119°							82	164
33°-117°							19	19
117°							633	582
117°							1,758	1,023
118°							5,211	3,720
118°	32	6	.188				2,131	990
118°							3,524	3,136
119°	16	2	.125				876	639
119°							253	234
33°-117°							102	178
117°							850	430
118°							728	334
118°							370	160
118°							321	252
119°							914	835
33°-118°							69	18
35°-121°				8	20	2.500	8	20
35°-121°				32	70	2.188	32	70
35°-121°				57	45	.789	57	45
36°-121°	15	16	1.067				15	16
Total	63	24	0.381	97	135	1.392	28,380	20,098

33 ₄ -118 ₀								22	32	1.455
118 ₁								233	57	.195
118 ₂								261	48	.184
118 ₃								184	49	.266
118 ₄								26	2	.077
118 ₅								29	5	.172
34 ₀ -118 ₁								121	16	.132
118 ₆								19	2	.200
118 ₇								12	2	.167
35 ₀ -120 ₁										
35 ₂ -121 ₀										
Total.....	839	520	0.620	14,881	13,764	0.925	46,506	60,996	1.312	

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–November, 1955—Continued

Area	September			November			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
29 ₁ –118 ₀	33	34	1.030	—	—	—	53	37
31 ₁ –117 ₂	686	1,334	1.945	—	—	—	24	25
32 ₁ –117 ₀	—	—	—	—	—	—	10,644	13,834
117 ₂	—	—	—	—	—	—	338	402
117 ₄	—	—	—	—	—	—	580	479
118 ₀	—	—	—	—	—	—	264	203
118 ₂	—	—	—	—	—	—	113	170
119 ₀	—	—	—	—	—	—	35	2
32 ₁ –117 ₀	32	33	1.031	—	—	—	123	142
117 ₂	—	—	—	—	—	—	949	1,133
117 ₄	—	—	—	—	—	—	2,219	3,603
118 ₀	7	2	.286	—	—	—	4,142	3,649
118 ₂	129	45	.349	—	—	—	3,537	3,271
118 ₄	—	—	—	—	—	—	149	244
33 ₀ –117 ₀	48	44	.917	—	—	—	81	52
117 ₂	15	12	.800	—	—	—	1,221	2,207
117 ₄	17	38	2.235	—	—	—	4,947	8,699
118 ₀	8	17	2.125	—	—	—	5,708	7,138
118 ₂	244	139	.570	—	—	—	2,404	2,171
118 ₄	68	36	.529	—	—	—	3,577	5,092
119 ₀	48	18	.375	—	—	—	639	676
119 ₂	14	2	.143	—	—	—	368	602
33 ₁ –117 ₂	—	—	—	—	—	—	198	299
117 ₄	42	13	.310	—	—	—	1,297	1,460
118 ₀	559	260	.465	—	—	—	5,785	7,050
118 ₂	1,794	1,186	.658	—	—	—	3,106	1,671
118 ₄	—	—	—	—	—	—	10,136	11,224
119 ₀	279	—	.667	—	—	—	2,590	2,623
119 ₂	—	—	—	—	—	—	3	2

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May–November, 1956

Area	May			June			July			August		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32°–17°	12	48	4.000	73	125	1.712	3,383	4,814	1.423	4,378	4,841	1.106
117°							34	72	2.118	11	14	1.273
117°				203	109	.537	1,987	2,283	1.149	106	39	.368
117°				29	70	2.414	607	651	1.072	17	8	.471
118°				102	43	.422	382	288	.735			
118°												
32°–17°							29	55	1.897	9	3	.323
117°							205	327	1.595	43	98	2.279
117°				64	58	.906	674	515	.764	1,932	1,836	.980
117°				345	440	1.275	3,391	3,131	.923	2,214	1,750	.780
118°				307	148	.482	927	697	.752	285	158	.554
118°				6	2	.333				190	257	1.353
118°												
33°–17°							24	8	.333			
117°							328	70	.213	88	28	.318
117°							918	499	.514	265	77	.291
117°							6,079	4,318	.710	5,394	4,202	.779
118°				50	44	.880	2,792	2,235	.801	12,269	10,188	.830
118°							844	842	.998	2,833	1,423	.502
118°				10	14	1.400	218	341	1.564	688	427	.639
118°							342	307	.868	175	97	.554
119°												
119°												
33°–17°							78	21	.269	56	10	.179
117°							775	380	.490	294	44	.150
117°							2,101	1,199	.571	655	260	.397
118°							1,418	1,163	.820	3,885	1,976	.509
118°							3,027	3,063	1.013	7,251	2,834	.391
118°				34	88	2.568	186	349	1.886	721	444	.616
119°												
119°										57	31	.544

33a-118a						21	16	.762				
118a						347	224	.646			494	.518
118b						19	11	.579			876	.511
118c											108	.326
119a											253	.748
119b											197	.938
120a												
34a-118a												
118a											2	.087
118b											38	1.632
119a											41	.519
119b												
34a-119a												
35a-120a												
121a												
121b												
35a-120a												
121a												
121b												
36a-121a												
122a												
122b												
37a-122a												
40a-124a												
41a-124a												
41a-124b												
41a-124c												
Total	12	48	4,000	1,265	1,263	0.998	31,191	27,896	0.894	47,076	32,860	0.698

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
May—November, 1956—Continued

Area	September			October			November			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32-17 ₀	160	97	.606	686	671	.978	84	17	.202	8,692	10,566
17 ₂				8	30	3,750				137	133
17 ₄	42	18	.429							2,338	2,449
18 ₀										729	729
18 ₂										653	331
32-17 ₀	34	18	.529	7	13	1,857				79	89
17 ₂										248	425
17 ₄	15	2	.133							2,685	2,411
18 ₀	32	3	.094	189	124	.656	147	169	1,150	6,318	5,617
18 ₂				52	6	.115				1,571	1,009
118 ₄	13	1	.077							209	260
33-17 ₀	26	3	.115							24	8
17 ₂										442	101
17 ₄										1,296	619
18 ₀	127	44	.346	80	12	.150	33	31	.939	12,470	9,112
18 ₂	75	28	.373	686	479	.698	134	25	.187	15,356	12,595
118 ₄	271	22	.081	220	144	.655				3,958	2,301
119 ₀	431	44	.102							1,317	812
119 ₂	60	9	.150							577	413
33-17 ₂										134	31
17 ₄	7	4	.571							1,076	428
18 ₀				742	77	.104				3,508	1,540
18 ₂	64	14	.219	191	14	.073	10	4	.400	5,558	3,167
119 ₀	880	191	.195							11,295	6,178
119 ₂	1,917	213	.111							2,823	1,006
										57	31
33-18 ₀										21	16
18 ₂	57	2	.035							1,357	720
118 ₄	10	2	.200							1,345	680
119 ₀	289	196	.678							1,345	304
119 ₂	321	164	.511							660	417
119 ₄	436	410	.940							646	607
120 ₀	343	63	.242							343	83

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APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–November, 1957

Area	June			July			August		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
32°-117°	1,192	834	.700	1,460	1,790	1.226	3,967	6,663	1.680
117°	60	65	1.083	72	50	.694	85	138	1.918
117.4	55	42	.764	469	734	1.565	289	163	1.547
118°	9	16	1.778	28	67	2.393	335	396	1.182
118.2				14	31	2.214	296	370	1.250
118.4							146	211	1.445
119°							19	75	3.947
32°-117°	22	22	1.000	8	6	.750	26	20	.769
117°	489	586	1.198	544	814	1.496	69	88	1.275
117.4				8,437	8,697	1.031	2,151	3,137	1.458
118°				2,157	1,804	.836	3,336	3,133	.939
118.2	175	151	.863				3,464	3,288	.949
118.4							68	56	.824
33°-117°				8	5	.625			
117°				56	37	.661			
117.4				257	311	1.210	81	52	.642
118°				2,890	1,580	.547	411	348	.847
118.2				307	344	1.121	186	102	.548
118.4				235	131	.557	10	1	.100
119°				117	78	.667	45	6	.133
119.2				147	39	.265	36	10	.278
120°							29	3	.103
33°-117°				24	7	.292			
117°	121	30	.248	88	44	.500	164	188	1.146
118°				1,201	1,021	.850			
118.2	46	27	.587	673	613	.905	219	103	.470
118.4				2,353	1,116	.474	207	98	.425
119°				238	62	.261	118	43	.364
119.2				57	40	.702	9	5	.556

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APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–September, 1958

Area	June			July			September			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
32°-117°-	311	223	.717	3,842	4,396	1.144	4,153	4,619	1.112	4,153	4,619
117°-	12	12	1.000	298	564	1.893	310	576	1.858	310	576
118°-	---	---	---	39	42	1.077	39	42	1.077	39	42
118°-	---	---	---	22	80	3.636	22	80	3.636	22	80
32°-117°-	58	16	.276	633	925	1.461	691	941	1.363	691	941
118°-	---	---	---	111	21	.189	111	21	.189	111	21
33°-118°-	---	---	---	21	150	7.143	21	150	7.143	21	150
33°-118°-	---	---	---	19	52	2.737	19	52	2.737	19	52
35°-120°-	---	---	---	---	---	---	8	1	.125	8	1
Total.....	381	251	.659	4,985	6,230	1.250	5,374	6,482	1.208	5,374	6,482

APPENDIX H—Continued
**California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
 August–October, 1959**

Area	August			September			October			Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish
36°–122°							6	6	1.000	6	6
40°–124°				10	15	1.500				10	15
40°–124°	4	18	4.500							4	18
Total	4	18	4.500	10	15	1.500	6	6	1.000	20	39

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–September, 1960

Area	June			July		
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
314-1172						
322-1170	435	524	1.205	1,084	3,143	2.899
1174	682	1,202	1.762	22	0	0.000
1180	219	164	1.749	315	1,534	4.870
1182	518	774	1.494	662	1,876	2.834
1184	8	17	2.125	2,515	7,751	3.082
1186				124	369	2.976
				1,561	6,569	4.208
320-1172	23	89	3.870	5	0	0.000
1174	42	110	2.619	1,857	4,467	2.405
1180	1,297	1,954	1.507	758	2,410	3.179
1182	3,000	4,160	1.387	550	1,924	3.498
	73	32	.438	55	62	1.127
330-1172						
1180				32	12	.375
1182	96	203	2.115			
332-1180						
350-1204						
1210				68	67	.985
352-1212						
Total	6,393	9,229	1.444	9,608	30,184	3.142

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June–September, 1960—Continued

Area	August				September				Total	
	Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler	Anglers	Fish	Anglers	Fish
314-1172	588	2,970	5.051				1,672	6,113		
322-1170	34	92	2.706				491	616		
1174		3,334					997	2,736		
1180	951		3.506				1,852	5,374		
1182	1,725	9,066	5.256	39	21	.538	4,797	17,612		
1184	12	74	6.167				144	460		
1186	2,189	12,320	5.628	51	30	.588	3,801	18,919		
324-1172							28	89		
1174	673	3,756	5.581				2,572	8,333		
1180	267	1,736	6.502				2,322	6,100		
1182	502	2,848	5.673	46	148	3.217	4,098	9,080		
1184	43	0	0.000				171	94		
330-1172				12		.083	12	1		
1180					1		32	12		
1182	50	55	1.100				146	258		
332-1180	40	102	2.550				40	102		
350-1204	44	21	.477				44	21		
1210	35	33	.943				103	100		
352-1212	73	55	.753				73	55		
Total	7,226	36,462	5.046	148	200	1.351	23,375	76,075		

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June—October, 1961

Area	June				July			August		
	Anglers	Fish	Fish per angler		Anglers	Fish	Fish per angler	Anglers	Fish	Fish per angler
31 ₄ -117 ₂					662	1,486	2.245	849	1,943	2.289
32 ₂ -117 ₂	11	2	.182		227	445	1.960			
117 ₂					1,541	4,642	3.012	72	21	.292
117 ₄	12	4	.333		4,301	13,589	3.019		2,216	3.743
118 ₂	9	1	.111		340	1,113	3.274	1,784	5,353	3.001
118 ₄					878	2,868	3.267	3,837	10,683	2.779
118 ₆					180	292	1.622	139	240	1.727
119 ₂	7	9	1.286		24	41	1.708	108	301	2.787
119 ₄										
32 ₄ -117 ₂					76	87	.882	18	113	6.278
117 ₂					1,320	6,261	3.261			
117 ₄	64	169	2.641		4,827	12,611	2.613	259	686	2.649
118 ₂					18,674	39,660	2.124	2,852	6,159	2.175
118 ₄	28	1	.036		2,959	6,783	2.292	4,474	13,698	3.062
118 ₆								3,051	7,526	2.467
119 ₂								102	454	4.451
119 ₄										
33 ₂ -117 ₂					225	217	.964			
117 ₂					5,097	11,224	2.202	14	24	1.714
118 ₂					10,287	23,823	2.316	753	1,762	2.340
118 ₄					569	986	1.733	187	494	2.642
33 ₄ -117 ₂								479	853	1.781
117 ₂					138	217	1.572			
117 ₄					382	837	2.191			
118 ₂					1,213	1,425	1.175	31	25	.806
118 ₄					87	16	.184			
118 ₆					97	50	.515			
119 ₂					22	43	1.955			
119 ₄					19	97	5.105	153	73	.477
34 ₂ -119 ₂										
119 ₄										
35 ₂ -121 ₂										
37 ₂ -123 ₂										
123 ₂										
Total.....	131	186	1.420		54,945	128,793	2.344	19,734	52,604	2.666

APPENDIX H—Continued
California Partyboat Albacore Catch by 20-Minute Areas of Latitude and Longitude
June—October, 1961—Continued

Area	September				October			Total	
	Anglers	Fish	Fish per angler		Anglers	Fish	Fish per angler	Anglers	Fish
31 ₄ -117 ₂ -----	171	384	2.246					1,682	3,813
32 ₂ -117 ₀ -----	27	11	.407					337	479
117 ₂ -----								1,541	4,642
117 ₄ -----	72	1	.014					5,177	15,810
118 ₀ -----	33	21	.636					2,166	6,488
118 ₂ -----	84	165	1.964					4,799	13,696
118 ₄ -----	32	110	3.438					358	651
119 ₀ -----	117	333	2.846					249	675
111-----	111	593	5.342					111	593
119 ₂ -----	34	223	6.559					34	223
32 ₄ -117 ₀ -----								94	180
117 ₂ -----	25	0	0.000					1,920	6,261
117 ₄ -----	17	0	0.000					5,175	13,466
118 ₀ -----	154	161	1.045					21,523	45,819
118 ₂ -----	100	417	4.170					7,615	20,643
119 ₀ -----	41	112	2.732					3,151	7,943
119 ₂ -----	244	386	1.582					143	566
33 ₀ -117 ₂ -----								244	386
117 ₂ -----	26	26	1.000					225	217
118 ₀ -----								5,111	11,248
118 ₂ -----								11,066	25,611
118 ₄ -----								756	1,480
33 ₂ -117 ₂ -----								479	853
117 ₂ -----								138	217
118 ₀ -----	25	2	.080					382	837
118 ₂ -----								1,269	1,452
118 ₄ -----								16	50
119 ₀ -----								87	170
119 ₂ -----								97	43
34 ₀ -119 ₂ -----								22	170
119 ₂ -----	15	1	.067					172	170
119 ₄ -----					73	201	2.753	15	1
35 ₂ -121 ₂ -----	30	55	1.833					73	201
37 ₂ -123 ₀ -----	4	4	1.000					30	55
123 ₂ -----	26	102	3.923					4	4
Total-----	1,388	3,107	2.238		73	201	2.753	26	102
								76,271	184,891

